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EDITORIAL ANNOUNCEMENTS.

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CONTRIBUTIONS.—Subscribers and others will materially assist in making our news accurate and complete if they will send early information of events which take place under their observation. Discussions of subjects pertaining to all departments of railroad business by men practically acquainted with them are especially desired.

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VOL. XLIV., No. 4. FRIDAY, JANUARY 24, 1908.

Modern transportation affords so many luxuries that we carelessly assume that it can give us everything. Having got a car of oranges through from California in ten days we expect the railroads to bring all cars of all freight through in the same time. Why not? We make close connection at a junction every day for two months; why should we miss connection (and waste two hours) three times in the next ten months? The telegraph is infinitely faster than the locomotive, yet it bothers us in the same way. A broker telegraphs from New York to Chicago and gets his answer in five minutes or less; why do ordinary messages sometimes take six hours? These facts of experience are called to mind by a letter in a New York paper from a complaining passenger. He says:

> My wife and two children boarded the Second Empire for Rochester at the Grand Central Station, New York, on Dec. 23. I accompanied them as far as Albany. An hour before arriving there I was informed that the car we were in would be taken off at that station, and that I had better take my family into the crowded car ahead. The train arrived in Albany promptly at 3:57 p. m., and left on time, 4 p. m. In the interim of three minutes I managed with much trouble and inconvenience, to find a place for them in the car ahead. They were hardly seated when we were told to return to the car we had just left, as it had been decided to take off the car we had been sent into. Meanwhile the crowd at the Albany station was permitted to crowd in. My wife and I managed to carry our boy, two and a half years old, and an infant, one year old, together with winter wraps and baggage, back into the original car we had boarded at the Grand Central Station. I had to jump from the car, going at about seven miles an hour, to avoid being carried beyond Albany. The change-car performance was repeated at Utica, where my wife was compelled to make two trips with children and baggage through two parlor cars and a diner.

That passenger, no doubt, is mad enough to blame the company for all his troubles, even if he were to be shown that he himself was partly responsible; yet his case is not so clear as it seems. In the first place he should have inquired as to the best time to change. He would have been told to go forward just before reaching Albany. The party should have gone to the center of the forward car, there to stand until the Albany passengers vacated seats. Then the woman and children would at least have been somewhat calmed and prepared for the return journey. Remaining in the train to assist his wife to settle herself may have seemed to this man reasonable, as it does to some people to throw kisses after a train till sometime after it has vanished from sight; but it is utterly unreasonable, unless one is willing to limit himself not only to the time allowed by the time table, but to a considerably less time. It is a gross imposition on passengers entering a train to be knocked over by men hurrying out at the last moment. It is a pity that there is no way to regulate these people who lack the fortitude to say good-bye at the gate. (This man's estimate of the actual stop in this case appears to be wrong.)

The car inspectors may or may not have been negligent. Taking off the forward car was probably due to some fault which was discovered after the train stopped; and not even a critical passenger will ask that all defects in trucks shall be discovered while trains are in motion. The limiting of the stop to three minutes is also a feature that the passenger will agree is unavoidable, if he belongs to that great majority who demand that every train shall reach its destination in the shortest possible time. As this man gives no particulars, it is to be assumed that the leaving and entering crowds at Albany avoided each other with reasonable decency; but we should not have been surprised if he had found two-thirds of the passengers entering at the wrong door and many persons waiting for others to get out of their way when they might have been moving if properly instructed. By intelligent co-operation between stationmen and trainmen passengers might be saved a great deal of unnecessary annoyance. Why do not stationmen direct passengers, two minutes before the train arrives, to gather at the most favorable point on the platform? Where there are two or three cars in a train, a trainman ought to be watchful and show passengers where seats are most plentiful, possibly remaining on the car platform or inside the car to stir up the car-seat hogs who are intrenching themselves against newcomers. In a dark train-shed the assistance given by brakemen is particularly welcome to passengers. (Why should not cars be lighted well—instead of by a single burner—when in a dark station?) On local trains where people have little hand baggage, these attentions to passengers' wants are less important, but a through train, stopping only three minutes at a big station, presents another problem. Quite likely the best way to cure these difficulties, in many cases, would be to lengthen three-minute stops to six minutes, and put the corresponding additional burden on the engine; but brakemen and platform men ought to be "jacked up" in any event. As to how this road came to be so unfortunate as to have to cut out two cars on a single trip, our complaining friend should go to the Public Service Commission. That body is going to investigate obscure causes of delays.

The courts have succeeded the legislatures. The opinions now being handed down dealing with the state railroad legislation of 1907 are not temporary restraining orders granted for the sake of preserving equitable rights pending judicial determination of the

facts, but the formal opinions of judges arrived at after mature consideration. Two decisions were given on Monday which will serve to remind the thoughtless legislator that railroads as a class are still entitled to be treated with the same careful fairness and justice as private citizens. One of these decisions was by Judge Smith McPherson, in the United States District Court at Kansas City, Mo. It dealt with a statute passed by the Missouri legislature in 1907 forbidding foreign corporations from transferring suits brought against them from the courts of the state to federal courts on pain of forfeiture of their charters. Both in Missouri and in Arkansas and Alabama, which also in 1907 passed similar laws, federal judges had straightway issued temporary injunctions prohibiting the states from enforcing any of the penalties laid down in these laws, pending decision as to their constitutionality. The decision of Judge McPherson is, we believe, the first final decision which has been handed down in one of these cases. As long as we have a federal government and a constitution there can be no great doubt as to the fate of such laws as these, but the gist of Judge McPherson's opinion is worth quoting for the brevity and accuracy with which it sums up the absurdity of such laws. He holds as follows:

"The Missouri statute of 1907 is void because it allows a resident company to sue in the federal courts if there is a federal question and denies that right to a non-resident company; and because it seeks to take from the complainant a right which is given by the Constitution."

The application of various railroads of the state for a permanent injunction to prevent the secretary of state from enforcing the law was therefore granted. The attorney-general of Missouri has announced that the case will be appealed, but we fail to see any reasonable chance that this law will be upheld. The other decision was given by the Supreme Court of Pennsylvania, which, on a close division—4 to 3—in effect overthrew the 2-cent passenger rate law passed by the legislature in 1907. This was an affirmation of a decision made in September, 1907, by the Common Pleas Court for the district of Philadelphia, which declared the 2-cent fare law could not be enforced against the Pennsylvania Railroad because it was confiscatory. From this last decision there is no possible appeal, and the Pennsylvania, which on October 1 reduced its rates to 2 cents a mile, in spite of the favorable decision of the lower court, is now free to make a general increase in passenger rates. The majority opinion of the Supreme Court was given by Justice Mitchell, who took occasion in the course of it to say in substance:

The point of injustice is reached long before that of confiscation, and in putting the legal estimate of legitimate profit at 6 per cent. there are other elements which would justify much larger earnings. Injustice is done by any failure to consider these.

Passenger and freight traffic should be separately considered, otherwise freight rates would be inequitable, so that passenger travel might be cheap.

While the public has certain rights, which in case of conflict must prevail, yet it must not be forgotten that even so-called public service corporations are private property, organized and conducted for private corporate profit. Assuming that it fulfills its duties to the public, a corporation is entitled to a fair profit on every branch of its business just as a merchant or manufacturer is.

One of the minority opinions declared that the rate of 2 cents a mile is not unreasonable; another that the exact effect of the law cannot be determined on account of the complex nature of the railroad business, and another that the effect of the act on the gross earnings, and not alone on the earnings from passenger traffic, should have been considered. The practical application of the decision is complicated by the fact that directly it applies only to the Pennsylvania, but in effect it apparently applies to all the railroads of Pennsylvania.

COAL ROADS UNDER THE RATE LAW.

The "commodities clause" of the Rate Law makes it unlawful for a common carrier to transport in interstate commerce after May 1, 1908, any commodity except timber, "manufactured, mined or produced by it or under its authority, or which it may own in whole or in part, or in which it may have any interest direct or indirect," except for its own use. This section of the law affects mainly the anthracite coal roads and also some railroads which own bituminous coal companies. Its strict enforcement four months hence could hardly fail to cause great losses to the holders of many kinds of railroad securities, both because many railroad companies would have to sell property at a time when values are low, and because the uncertainty attending the method of separation of railroads and coal properties combined as security under the same mortgage would reduce current prices. Application of this section of the law would also upset the whole anthracite coal trade, by making illegal the present methods of marketing. It is, therefore, with a great deal of relief that the anthracite coal roads have received the following statement made on January 17 by Attorney-General Bonaparte, covering the "commodities clause":

It is clear that this clause if valid will make it impossible for many railroads which own coal mines to transport the coal to market after the date named, and it is understood that some of these railroads have been advised by their respective counsel that the above quoted provision of law is unexceptional. The Department of Justice contemplates the institution of proceedings, as soon as possible after the date named, whereby a prompt determination of this question by the Supreme Court of the United States may be obtained. It is expected that the railroads concerned will co-operate with the Government to this end, and if they do so in good faith, and if they in good faith and immediately obey the decision of the Supreme Court when tendered it is not the purpose of the Department of Justice to prosecute them for a failure to comply with the terms of the act pending the decision of the Supreme Court.

There are two railroads which had already made clear their position in regard to this section of the Rate Law. The Buffalo, Rochester & Pittsburgh in December, 1906, sold the Rochester & Pittsburg Coal & Iron Company, whose stock is deposited as part of the security for the railroad's general mortgage bonds of 1937, to the Mahoning Investment Company, subject, however, to the lien of this mortgage. For the $4,000,000 stock of the coal and iron company the railroad received a little more than $4,000,000 of the stock of the investment company, which it distributed pro rata among its stockholders. Whether or not transferring coal properties to a separate company, presumably controlled in exactly the same interest as the railroad satisfies this law, is a question. It would certainly seem that in this case the railroad still has at least an indirect interest in the company which mines the coal.

The other company which has outlined its position on this section of the law is the Delaware, Lackawanna & Western. In the annual report for the year ended December 31, 1906, President Truesdale speaks as follows in regard to this section of the Rate Law: "The avowed purpose of this law was to compel companies such as this to dispose of their coal properties, thus separating the transportation of coal from the mining and merchandizing thereof. The management is advised by its legal representatives that this company cannot be required to dispossess itself of its coal properties by the action of Congress under the guise of regulating commerce between the states, especially as by the terms of its charter —one of the early ones granted by Pennsylvania—it has the undoubted right to mine, purchase, transport and merchandize coal." This flat denial of the right of Congress to compel the disposal of their coal properties is likely to be the position taken by all those companies which have early charters granted by the state of Pennsylvania specifically giving them the right to engage in the coal business. One of the anthracite roads holds even a stronger position than this. The Delaware & Hudson, though usually spoken of as if it were the Delaware & Hudson Railroad, is the Delaware & Hudson Company, the direct successor of the Delaware & Hudson Canal Company, which was a canal and coal mining company which owned and leased railroads. However, the general question of the constitutionality of this section of the law is settled by the United States Supreme Court, the case of this road will involve special technicalities.

Besides the anthracite roads, other roads which are in one way or another interested in coal properties, are the Buffalo & Susquehanna; Pittsburgh, Shawmut & Northern; New York Central; Pennsylvania; Baltimore & Ohio; Western Maryland; Norfolk & Western; Chesapeake & Ohio; Hocking Valley; Evansville & Terre Haute; Louisville & Nashville; Missouri Pacific; St. Louis, Rocky Mountain & Pacific; Denver & Rio Grande; Union Pacific; Great Northern, and Lake Shore & Michigan Southern. These last two roads are included in the list because they own stock in subsidiary companies, which subsidiary companies own coal mining companies; the Great Northern, the Lake Superior Company; and the Lake Shore & Michigan Southern, stock of the Lehigh Valley and of the Reading Company, which controls the Philadelphia & Reading Coal & Iron Company. The ownership of coal properties by the railroads ranges all the way from direct ownership of coal lands by a railroad company to ownership of a railroad company by a coal mining or by a manufacturing company like the Tennessee Coal, Iron & Railroad Company, part of whose business is mining coal. A decision on the part of the United States Supreme Court that this section of the Rate Law is constitutional will necessarily be followed by much litigation, for there are so many forms and degrees of ownership, control or indirect interest in coal properties by railroads, and *vice versa*, that a large number of individual cases will have to be decided to establish enough precedents to cover the whole ground.

RAILROAD BONDS AS FINANCIAL POINTERS.

The place of the railroad bond in this country as an index of financial conditions is becoming more and more definite. In the first place the volume of that class of security has grown to be immense even allowing for the competition of the industrial bond and, in a localized sense, of the street railway bond. The railroad bond has thus the high status derived from its relative magnitude as a vested interest. It also has the dignity of age based upon a form of property and investment which goes back for more than three-quarters of a century and, contrasted with which, almost all other classes of bonds, except public or realty securities, seem of mushroom growth. Finally it has the reputation of conservatism. To be sure it has had its periods of gloom. Railroads, like other properties, have had their receiverships, their bond foreclosures, their reorganizations; and not many years ago came that vicious form of speculative high finance when the capital stock of high class roads was translated into bonded debt and new and relatively valueless stock issued for purposes of control pure and simple. Still, allowing for all its mutations and vicissitudes, the railroad bond has generally asserted its value. The senior bonds of a strong railroad becomes the first and earliest investment of the capitalist, large or small, in his reaction from the terrors of a panic. The long "drag" of five years following our great panic in the autumn of 1873 depressed greatly railroad stocks and kept them down; but during the same time the interest return on high grade railroad bonds fell from 7 to 4 per cent. or a little more. The railroad share, even of a conservative railroad, fell; the conservative railroad bond rose.

In the present stage of recovery from the panic conditions of the closing months of 1907 the same transfer of funds, many of them lately hoarded, into high class railroad bonds is to be observed. But the situation varies much from that in 1873 and the succeeding years. There was then no great mass of "undigested" securities, many of them railroad bonds, waiting to be poured upon the market. There were practically no underwriters holding such securities in stock awaiting liquidation. There were in 1873 a considerable number of railroads caught by the panic in process of construction; but it is doubtful whether, in their total, they were more than a moderate fraction of the various forms of railroad improvements more or less tied up now and awaiting a better market for loans, and those loans, in turn, depending measurably on a recovery in railroad earnings itself based partly upon an uplift of productive industry. Finally, overhanging the situation like a summer cloud, is the coming period of maturity of the so-called "short notes" of the railroads added to the natural maturity of regular funded obligations. In round numbers about $117,000,000 of these short notes of the railroad companies mature this year; about $71,000,000 in 1909; and about $235,000,000 in 1910. To these are to be added about $215,000,000 of regular railroad bond maturities during the three years besides some $65,000,000 of equipment notes or bonds. The impressive total of the maturities of the three years is approximately $703,000,000, of which $179,000,000 mature during the year 1908. It is an imposing sum; and, as it must be liquidated mainly by railroad securities senior to stock, the railroad bond, both as a liquidating force and as an index of the situation, leaps to fresh prominence.

The pessimist, or in the vulgate of the street, the habitual "bear," naturally lays stress upon the bigness of the figures and talks in the language of despondency. But a blow runs through his major premise. He talks as though the whole of these railroad liabilities must be met with *cash*. They are in fact liabilities actually outstanding to be replaced by others without increase of the debt. Of the total maturities only about 25 per cent. fall due in the present year, and of these about 22 per cent. are old long time mortgage bonds easily refunded. It is noteworthy also that of the old railroad bonds falling due during the coming three years, out of 55 issues 32 represent old 6s and 7s sure to be refunded at a lower rate and with a considerable annual saving of interest. The reverse is true, however, of the equipment issues of the three years of which almost the whole of the $65,000,000 were marketed in low rate interest periods, very few of them as high as 5 per cent., and most of them to be refunded probably at a higher rate than they bear now. Some $22,000,000, or about one-third, fall due in the present year. Of the railroad short notes, so copiously marketed during the last year or two, $423,000,000 fall due within the three years. They are, for the most part, 5 per cents. and refunding at that rate or lower ought to be feasible—considerably lower if a mortgage bond is substituted. Of the whole $703,000,000 to be met during the three year period only a very small part is likely to call for cash and the only question in liquidation will be the market value of the refunding bond.

In this vital question of the future, the potency of refunding bonds, the year, especially considering the fact that the market has but just emerged from panic conditions, starts off very encouragingly. In the face of adverse prophecies the New York Central has refunded the $14,000,000 of Canada Southern bonds and has placed its $30,000,000 of new equipment notes. The New York, New Haven & Hartford has negotiated successfully its $39,000,000 of debentures. On the basis of present market values the index rate of the three loans is about 5 per cent., and only in one case is there high mortgage security. Three new railroad loans alone thus, in amount, represent $83,000,000, or about 71 per cent. of the whole of the $117,000,000 of short notes falling due in 1908, or about 60 per cent. if the 1908 equipment notes of the railroads are included. Taking another test one finds, since the recent recovery of the market, the high grade mortgage bond back at the 4 per cent. basis—for example West Shore 4s—total issue $50,000,000—selling at above par, or Union Pacific first mortgage 4s—total issue $100,000,000—a trifle below par. As a pointer to the future the railroad bond of the substantial and dividend paying corporations thus responds cheerfully. There are, of course, adverse contingencies. Nobody knows just what is the volume of undigested securities, some of them underwritten, waiting for a better market. Nobody can measure with exactitude the length and depth of the industrial drag; and, after the chastening experience of the last few months, every motive urges railroad corporations toward economy and conservatism. But, with that motive harvesting results, the railroad bond, so far as it is a solvent of the situation, points toward clearing weather rather than toward cloud and storm.

Train Accidents in December.[1]

Our record of train accidents occurring on the railroads of the United States in December includes 14 collisions and 10 derailments, 24 accidents in all. This record is not published in full except in the cases of the few accidents which are especially prominent—in the present instance four collisions and two derailments. The record of "ordinary" accidents—which term includes, for our present purpose, only those which result in fatal injury to a passenger or an employee or which are of special interest to operating officers—is given at the end in the shape of a one-line item for each accident, showing date, location, class and number of deaths and injuries. The items of which details are given are indicated in the tabular statement by the use of italics. This record is based on accounts published in local daily newspapers, except in the cases of accidents of such magnitude that it seems proper to send a letter of inquiry to the railroad manager.

The rear collision of passenger trains at Hanover, Md., on the 4th, killing five passengers, appears to have been due to the negligence of the engineman of the following train who had passed two automatic block signals set against him (at Sand Pit and Harwood) one and two miles west of Hanover respectively. The leading train was a local passenger just starting away from the station, and the one following was an express. The men killed were passengers. The passengers injured were mostly in the rear car of the standing train, which was wrecked.

The collision near Worcester, Mass., on the 14th, was due to the presence of freight cars on the main track in the face of an express passenger train, the men in charge of switching operations having moved these cars to the main track without proper protection. An eastbound passenger train running at full speed on a descending grade crashed into and wrecked the freight cars and its engine was overturned. This part of the line is equipped with automatic block signals but the switch at which the freight cars

[1]Abbreviations and marks used in Accident List:

rc.....Rear collision.
bc.....Butting collision.
xc.....Other collisions; as at crossings or in yards. Where only one train is mentioned, it is usually a case of a train running into a standing car or cars, or a collision due to a train breaking in two on a descending grade.
b.....Broken.
d.....Defective.
dr.....Defect of roadway.
eq.....Defect in car or engine.
n.....Negligence.
unf.....Unforeseen obstruction.
unx.....Unexplained.
derail.....Open derailing switch (negligence of engineman or signalman).
ms.....Misplaced switch.
acc. obst..Accidental obstruction.
malice....Malicious obstruction of track or misplacement of switch.
boiler.....Explosion of boiler of locomotive on road.
fire.....Cars burned while running.
Pass.....Passenger train.
Ft.....Freight train (includes empty, engines, work trains, etc.).
*Wreck wholly or partly destroyed by fire.
†One or more passengers killed.

were thrown to the main track has no indicator by which the men in charge of the switching movements could know when a train was approaching the entrance of that block section on the main line. A flagman had been sent out by the switching crew, and, a few minutes before, he had stopped a train and the main track had been cleared for it; but it appears that his signal was not seen by the engineman of the passenger train. There was a blinding snow storm at the time. This engineman at last accounts had made no statement, being confined to the hospital. The engineman was the only person seriously injured.

The collision at Camden, N. J., on the 27th, causing the death of three passengers, occurred on a block signaled line, but appears to have happened close to the terminal, where the space interval was not enforced. A train from Pemberton ran into the rear of one from Atlantic City. The speed was not high but it appears that the tender of the engine of the Pemberton train penetrated the first passenger car behind it and that the fatalities occurred in this car. There was a dense fog at the time of the accident. The newspapers say that since the collision an order has been issued to enforce the block system on this part of the line.

The collision near Lenox, Mich., on the 27th, also occurred in a dense fog. The freight train, with two engines, was standing on a side track and it appears that the switch connecting with the main track had not been set right. The five men killed were all trainmen; two enginemen, two firemen and a brakeman.

The derailment at Shenandoah Junction, W. Va., was caused by a rear collision of freight trains. This collision did not do great damage but the wreck fouled the adjacent track, on which the passenger train was running. The conductor and flagman of the freight train which was run into are held blameworthy for not having properly signaled the following train. Testimony was given before the coroner that the conductor was asleep in his caboose.

The derailment at Marshall, Colo., on the 24th, was of a kind which has been heard of before in Colorado but rarely in other states. Two passenger cars and a baggage car were thrown from the track and lodged some distance away and the express car was overturned. The engine remained on the track. In former years the derailment of trains by high wind was reported nearly or quite every winter in Colorado, but the trains which suffered were made up of narrow-gage cars and engines, which were both light and top heavy; but the accident now reported occurred on a line which is recorded in the *Official Guide* as standard gage.

Train Accidents in the United States in December, 1907.

Collisions.

Date.	Road.	Place.	Kind of Accident.	Kind of Train.	No. persons reported Kil'd.	Inj'd.
2.	*Baltimore & Ohio*	Shenandoah Jc.	rc.	Ft. & Ft.	0	9
3.	Tol., St. Louis & W.	Kokomo.	bc.	P. & Ft.	0	5
†4.	*Baltimore & Ohio*	Hanover.	rc.	P. & P.	5	25
5.	Baltimore & Ohio	Adams.	bc.	Ft. & Ft.	2	1
8.	Lehigh Valley	Parryville.	rc.	Ft. & Ft.	1	2
10.	Chic. & North-Westn.	Beloit.	bc.	P. & Ft.	0	2
14.	*Boston & Albany*	Worcester.	xc.	P. & Ft.	0	3
15.	Union Pacific	Green River.	xc.	P. & Ft.	1	0
20.	Louisville & Nashville.	Calera.	bc.	P. & Ft.	0	4
25.	Baltimore & Ohio	Chicago Junc.	xc.	P. & Ft.	1	0
26.	Lake Sh. & Mich. S.	Franklin.	bc.	P. & Ft.	1	4
†*27.	*W. Jersey & S.*	Camden.	rc.	P. & P.	3	17
27.	*Grand Trunk*	Lenox.	bc.	P. & Ft.	5	1
29.	Southern Pacific	Franklin, La.	xc.	Ft. & Ft.	2	4

Derailments.

Date.	Road.	Place.	Kind of train.	Cause of derlmt.	No. persons reported Kil'd.	Inj'd.
2.	Southern	Mobile.	Pass.	malice.	2	3
†2.	*Baltimore & Ohio*	Shenandoah Jc.	Pass.	acc. obst.	3	12
5.	Pennsylvania	Pittsburgh.	Pass.	ms.	0	13
6.	Central, Georgia	Utopia.	Pass.	unx.	0	4
8.	Louisville & Nashville.	Montgomery.	Pass.	ms.	1	0
10.	P., C., C. & St. L.	Frazeysburg.	Pass.	unx.	0	3
18.	Union Pacific	Concordia.	Pass.	b. rail.	1	2
22.	Southern.	Tallapoosa.	Pass.	ms.	1	1
22.	Pennsylvania	Bolivar.	Pass.	acc. obst.	0	4
†24.	*Colorado & Southern*	Marshall.	Pass.	wind.	1	6

Of the eight street car accidents of greater or less importance reported in the newspapers in December, none is charged with having caused any fatal injury.

CONTRIBUTIONS

The Griffin Double-Tread Car Wheel.

Buffalo, N. Y., Dec. 30, 1907.

To the Editor of the Railroad Gazette:

On account of absence from home I saw only recently the description of the double tread car wheel, published in your issue of November 8. There are some points in the article that should be corrected. The patent was not issued to the New York Car Wheel Company. It is the intention to arrange for the manufacture of this type of wheel, under proper conditions, with any car wheel makers throughout the country who may wish to make such arrangements, in order that the wheels may be obtained at any desired point or in any desired quantity. I would also like to correct the inference, which might be drawn from your description, that the inner tread would not be subject to brake heating. The friction from brakes would heat the inner tread the same as it does the outer one; the important point is that the heating of the inner tread would not set up dangerous conditions, or interfere with the wearing capacity of the wheel in the manner that such conditions now affect the outer tread. In order to have a proper understanding of the whole matter, I beg to give herewith the reasons that lead me to believe that this new type of wheel will remedy the present unsatisfactory conditions of wheel service.

In order to produce a car wheel that will successfully meet

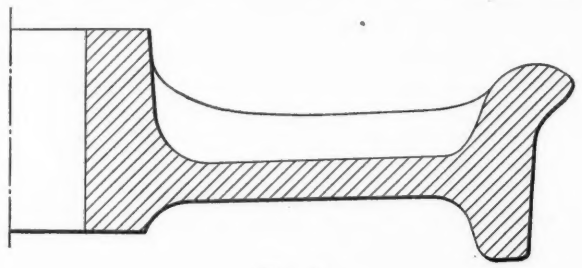


Fig 1.

the severe requirements of heavy car and locomotive service, there must be some change or improvement in the present type of wheel. Under 50-ton cars and heavy locomotives the wheel load has nearly doubled; in passenger car service, the increased load and speed develop brake service conditions that are proving very disastrous to every type of wheel used, whether steel or iron. At present all of these strains fall on the single outer tread, and it is manifest that if they can be divided so that an outer tread is subjected to rail wear only, while the inner tread takes the strains arising from brake service, the life of wheels will be increased, and the dangers involved in having all strains imposed on the single outer tread will be averted.

During the past 50 years the standard freight car wheel used in America has been the chilled wheel. The manufacture of such wheels began in a limited way in the United States about 60 years ago and the section of wheel first used was known as "single plate" (see Fig. 1). When the weight of cars and locomotives began to increase, in the early sixties, it was found that the single plate wheel would not stand the expansion strains caused by the increased brake friction necessitated by heavier loads and higher speed. Cracks running through the single plate in line with the tread and extending afterwards to the tread became so prevalent,

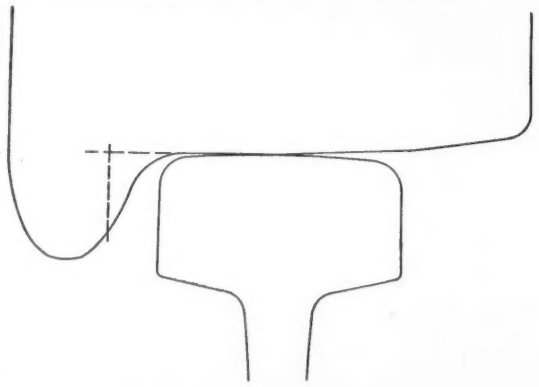


Fig. 2.

and broken wheels became so numerous, that it was necessary to find some means of overcoming the trouble. The double plate wheel was invented to meet the need.

One of the original types of this section, known as the Washburn double plate wheel, soon became the standard section for American railroads. This type of double plate wheel, made heavier from time to time to meet the increasing requirements of service, has remained ever since the standard section. Within the past few years, the rapid introduction of heavy equipment has produced two important results in the life of car wheels: First, more rapid wear on tread and flange; second, disintegration and burning of the metal in the wearing face of tread and flange by reason of increased brake friction.

Fig. 2 shows a section (half size) of the M. C. B. standard tread and flange, and an A. S. C. E. 85-lb. rail section. The vertical dotted line shows the limit of flange wear allowed under M. C. B. rules. When the limit is reached, the wheel must be removed from service. The difference in profile between throat of wheel and corner of rail against which the flange must bear may be noted, and also the actual section of metal that can be worn from the flange at throat of wheel before the latter is condemned as unfit for service. There can be no question but that the factors of wear and strain under 50-ton cars and heavy locomotives have been very heavily increased, and that the life of wheels will be correspondingly shortened.

The causes for which wheels are removed from service under heavy equipment show a marked increase in certain directions,

namely: cracks in the face of tread and in the throat of wheel at flange extending through the chilled surface, which arise from the heat caused by heavier braking friction; shelling, or crumbling, out of the metal in the face of tread when the life of the metal has been destroyed by constant heating from increased braking friction; and thin flanges, caused by more rapid wear due to heavier service. It may be seen that these three causes of wheel removals are connected entirely with the tread and flange, and that they arise principally from the results of brake service. It is also evident that proper control of the heavier equipment by means of brakes must produce greater heating on the tread and flange of wheel, and that therefore the life of wheels will be shortened as the use of the heavier equipment becomes more general.

Not only is the question of increased cost of wheel service due to the above conditions a serious matter, involving as it does the removal of the cars from service while wheel repairs are being made, but the factor of increased danger from broken wheels and broken flanges is one that must be provided for in some way. The breakage of wheel flanges due to the formation of cracks as above described is rapidly increasing, and very few wheels removed from heavy equipment fail to show groups of such cracks or long cracks made up of such groups when flanges are broken off with a sledge to determine if such cracks exist. It is not an exaggeration to state that nearly all wheels under heavy equipment will develop such defects sooner or later. Some remedy for these conditions must be found. The use of steel wheels has been proposed, but it remains yet to be seen to what extent steel wheels, or even steel-tired wheels, will be free from like conditions after being subjected for a similar length of time to the heavier car and locomotive service. The burning of the metal due to heavy brake friction produces effects as disastrous on the steel wheel as on the chilled wheel.

The fact that the chilled wheel has been, practically, the standard wheel used under all freight equipment in America during the past 50 years, the low first cost and high scrap value it possesses, and the readiness with which it can be obtained from manufacturers in all parts of the country, certainly make it unique in its position among the important items of railroad equipment. If some way out of the difficulties created by the advent of the 50-ton car and the great increase in weight in all classes of railroad equipment can be found, it will be a very important advance in overcoming one of the great difficulties of present conditions of service. The rail problem is familiar to almost every one; the wheel problem is familiar enough to railroad officials and wheel manufacturers who appreciate its gravity, but it has not yet been publicly discussed as extensively as the rail question.

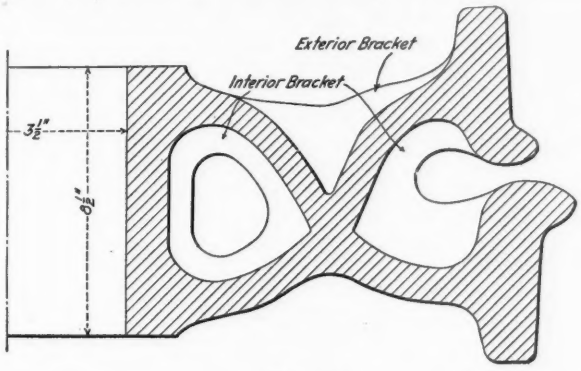


Fig. 3.

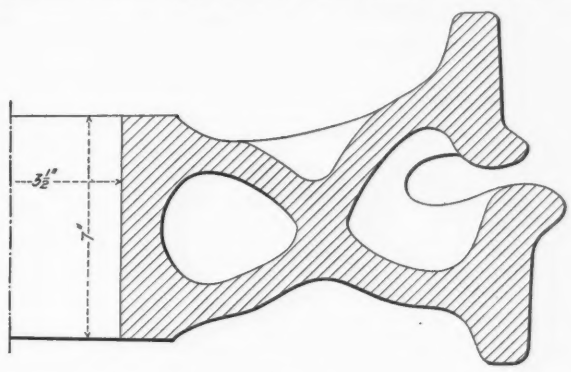


Fig. 4.

The standard section of 33-in. chilled wheel weighing 700 lbs., as now used by nearly all railroads under 50-ton cars, seems to possess ample strength in the body for the service required. The entire difficulty seems to lie in the tread and flange. Following the line of development from the single to the double plate wheel, it is now proposed to use a double tread wheel to avoid the increased failures caused by present conditions. Fig. 3 shows the Griffin double tread wheel, developed to this end. The fundamental purpose in the double plate wheel was to replace the straight line and section of the single plate wheel by the curved double plates connected with the hub and the curved single plate connected with the tread, the latter being supported by the curved brackets running from the double plates to the tread. The idea was that when the tread of wheel was heated and expanded by the application of brakes, the curvature of the double and single plates and brackets supporting the tread would permit the expansion of the wheel as a whole without the cracking or fracture which occurred in the single plate wheel. This was exactly what took place, and not only was this valuable object accomplished by the use of the double plate wheel, but the support of the load on wheel tread was distributed over a greater length of wheel seat in a proper manner by means of the double plate wheel section. It may be readily seen that if this type of wheel has carried the load and stood the effects of brake heating all upon the single tread, that by removing the effects of brake heating and wear from brake applications from the outer single tread, the life of the latter and of the wheel as a whole would be very much increased. Efforts have been made to find some means of accomplishing this, and with light equipment braking discs on the wheel, or separate braking discs on the axle have been tried. No satisfactory development along these lines, however, has yet been worked out, and in the case of 50-ton cars and heavy locomotives, the whole effect of brake friction, expansion from brake heating, and all other results of brake service fall upon the single outer tread.

In the case of the double tread wheel, it may be seen that the extra tread can be added to the present section of wheel so that the inner tread can meet all the conditions of brake service precisely as well as the outer tread now meets them, and with the additional advantage that the heating of the inner tread will not lead to the disastrous results now caused by the heating of the outer tread, for the reason that the inner tread never comes in contact with the rail. Brake friction may heat the inner tread, but this will not in any way impair its efficiency for continuous braking service, even if the small cracks referred to heretofore are produced. While it is proposed to add the inner tread to present wheel patterns in order that the manufacture of wheels according to the present standards will not be interfered with, it is also proposed on new or even on present equipment to increase the length of the wheel hub by 1½ or 2 in., in order to obtain an additional length of wheel seat, which experienced railroad officials state is needed under present conditions of service with heavy equipment. The diameter of axle at wheel seat has been increased to 7 in., which is the full length of the wheel hub, and it is manifest that the resistance of the wheel to displacement on the axle is less than it was when the wheel seat was smaller in proportion to its length. The section of proposed double tread wheel with longer hub is the one shown in Fig. 3, and the section of double tread wheel with double tread as adapted to present section and length of hub is shown in Fig. 4. These drawings show a flange on the inner tread to keep the brake shoe from touching the other flange; but if desired the wheel can be used without the second flange.

It will be necessary to move the brake-head about 5 or 6 in. on each end closer to center, to provide for proper contact with the inner tread. To properly clear all guard rails, switches and special work, the inner tread should be about 3 in. less in diameter than the outer tread, or a diameter of 30 in. as compared with the outer diameter of 33 in. Shortening the distance between points of strain on the brake-beam as stated will decrease the tendency to deflect under heavy pressure, and in case breakage of brake-head or shoe occurs the broken parts will fall between the tracks and not upon them or on the special work.

As a matter of foundry practice the manufacture of the double tread wheel is little more difficult than the manufacture of the present single tread wheel, the division between the outer treads being made with a suitable pan core in the same manner that the division of the double plates in the present type of wheel is now made. It is not necessary to go more fully into this matter at present. It can be explained to any one interested.

The additional weight of the inner tread would depend on the thickness of metal used. In the case of a 700-lb. standard wheel it is probable that the inner tread would add about 200 lbs. to the weight of wheel. As the metal on the inner tread would have the same scrap value as the rest of the wheel, the additional cost on account of extra weight can be determined.

It is proposed to use the double tread wheel for centers for steel-tired wheels as well as for the chilled wheels. As the inner tread will be chilled precisely in the same manner as the outer tread, it will provide the same resistance to wear of brake-shoes as the outer tread now does, and considering the serious damage to steel tires caused by brake application, it is manifest that to move this service to the inner tread would be a very great advantage. As cast-iron centers are now used generally in steel-tired wheels, it is not necessary to dwell further upon their suitability for such use.

If the double tread wheel will prove to be the means of re-

gaining the ground that has been lost in the length of service and other results obtained from the use of the chilled wheel, it can hardly be said that the extra cost of additional metal should prevent its use. The question of safety after all stands pre-eminent. When any important article of railroad equipment becomes unsafe for use through any change in service conditions, it is manifest that the continued use of such material becomes more than a question of economy, it becomes one of responsibility.

The double tread wheel may, or may not, prove a relief from present conditions of wheel service. In the opinion of the writer, based on many years of practical experience and investigation of such questions, it does provide the means of overcoming conditions for which some remedy must be found. This opinion is also strongly expressed by some very competent practical railroad officials to whom the matter has been presented. P. H. GRIFFIN.

SEVEN YEARS' RESULTS ON THE SEABOARD AIR LINE RAILWAY.

	Year ended June 30—						
	1901.	1902.	1903.	1904.	1905.	1906.	1907.
Average miles operated	2,592	2,604	2,607	2,611	2,611	2,611	2,611
Gross earnings	$10,426,280	$11,068,478	$12,156,928	$12,750,271	$13,619,274	$15,116,948	$16,427,943
Operating expenses	7,401,421	7,329,800	8,441,096	9,113,217	9,092,363	10,513,461	12,948,042
Earnings over operating expenses	3,024,859	3,738,679	3,715,832	3,637,054	4,526,911	4,603,487	3,479,901
Operating ratio, excluding taxes, per cent	70.98	66.22	69.43	71.47	66.76	69.55	78.82
Operating ratio, including taxes, per cent	73.88	69.66	73.00	75.66	70.30	72.97	81.97
Surplus	$252,676	$765,832	$750,432	$294,295	$1,084,092	$992,121	*$458,301
Capital expenditures	.....	.....	.....	650,937	481,584	925,564	1,487,393
Gross earnings per mile of road	$4,022	$4,251	$4.663	4,883	5,216	5,790	6,292
Net earnings per mile of road	1,167	1,436	1,425	1,393	1,734	1,763	1,333
Gross earnings per train-mile	1.394	1.430	1.521	1.558	1.640	1.695	1.789
Net earnings per train-mile	.404	.483	.465	.445	.545	.516	.379
Cost of maintenance-of-way, per mile of road	$539	$493	$569	$643	$694	$715	$846
Per cent. cond. transportation expenses to gross earnings	41.87	40.79	41.25	40.31	36.92	40.72	47.65
Rate received per ton per mile in cents	1.188	1.068	1.114	1.177	1.180	1.121	1.118
Rate received per passenger per mile in cents	2.480	2.357	2.286	2.342	2.327	2.382	2.362

*Deficit.

Seaboard Air Line.

Norfolk, Va., Jan. 15, 1908.

TO THE EDITOR OF THE RAILROAD GAZETTE:

Referring to your review of the annual report of the Seaboard Air Line in your issue of January 10, I beg to call your attention to one or two inaccuracies therein.

In the third paragraph you say: "In 1906 Alfred Walter succeeded James M. Barr, and would perhaps have succeeded in bringing about the regeneration of the property as he had earlier with brilliant success of the Lehigh Valley, but before his first year of service was over his health failed rapidly, and he died on February 27, 1907." When Mr. Walter assumed the presidency of the Seaboard, May 1, 1906, that property required no "regeneration"—this had already been effected; its operating staff was thoroughly efficient; the relations between the official staff and all employees were most cordial; the *esprit de corps* of the service was high; and the character of service rendered the public was fully equal to that of any road in the South Atlantic states.

When I took the management of this road as Vice-President, May 1, 1901, I found its transportation service inefficient, and its track generally in low physical condition. This was especially true of the lines in Florida, whose condition was the worst I ever saw in an experience of thirty years in railroad work. The transportation service was quickly brought to an efficient condition, and the track was improved gradually until its condition equaled that of any road in the same section. On account of light density of traffic, and meeting the cost of the improvements out of earnings, it was necessary to spread this work over several years; as the business handled increased, the expenditures were increased. The disability of the road was confined to its grade line, its inadequate facilities, and its decrepit freight equipment; and the results secured from its operation were as good as could be obtained thereunder. These things are matters of common knowledge throughout this section.

You will see from the statement enclosed that during the five years I was in charge of the Seaboard, there was no increase in the cost of conducting transportation per unit of service performed, notwithstanding the increased cost of wages and materials used in operation and maintenance; and that the rate received per passenger and per ton mile for the year ended June 30, 1907, was as high as that received therefor during a part of the period named.

When Mr. Walter took hold of the Seaboard he was a sick man, and in consequence did not possess the physical and mental vigor necessary to successfully cope with the conditions confronting him, and the resulting worry unquestionably hastened his death. At the time Mr. Garrett was placed in charge of the operation of the Seaboard by Mr. Walter, as Vice-President, the ratio of expenses to earnings was above 75 per cent.

Since May 1, 1906, the efficiency of the service secured from its employees by the Seaboard has declined, as the enclosed figures show, due in part to the many changes in its official staff; but the primary cause of its inability to earn interest charges was the failure of its owners to provide money to remove its disabilities, and thereby enable it to handle its business economically and efficiently.

I am writing you in this connection because I feel the reference to me, in your comments above quoted, is unfair. I have been a subscriber to and reader of your journal for many years, and this is the first time I have seen any attempt made therein to place responsibility where it did not belong.

J. M. BARR.

[The following is the statement enclosed by Mr. Barr.—EDITOR.]

Pennsylvania Two Cent Fare Law Void.

The Supreme Court of Pennsylvania has decided by a vote of 4 to 3 that the two-cent passenger rate law passed by the Legislature of 1907 is invalid so far as the Pennsylvania Railroad is concerned.

The decision applies specifically to the Pennsylvania Railroad because its appeal was the only case before the court. Chief Justice Mitchell wrote the opinion of the majority, Justices Fell, Elkin and Brown concurring. Separate dissenting opinions were written by Justices Mestrezat, Stewart and Potter.

The majority opinion says:

"The exact question to be determined on this appeal is not the general constitutionality of the act of 1907, but the right to enforce it against the appellee. The same clause in the Constitution that authorized its passage provides that such legislation shall do no injustice to the corporators of any company whose charter is thereby altered. Would the provisions of the act of 1907 do injustice to the corporators or the appellee?"

Chief Justice Mitchell finds that it would, and continues:

"Corporations are private property, organized for private profit, and unless necessary for the fulfilment of their corporate duties they should not be required to do any part of their business in an unbusinesslike way with a resulting loss. If part is unprofitable it is neither good business nor justice to make it more so because the loss can be offset by profit on the rest. Freight must not be made dear that travel may be cheap. The corporation is entitled to make a fair profit on every branch of its business, subject to the limitation that its corporate duties must be performed, even though at a loss."

Justice Mestrezat in his dissenting opinion declares that the majority conceded the right of legislative supervision of rates of common carriers, but declined to pass upon the immunity of the plaintiff company from such supervision. The reason given for this neglect, he says, is that counsel did not argue that question. He says that in determining whether a rate for transportation is reasonable or not all the revenues should be considered, including all the revenues from freight, expressage and all other sources. It is impossible to accurately determine what revenue the company receives from each of the several sources. It is clear that under the evidence, considering only the revenue from the passenger traffic, that the rate is not unreasonable, much less confiscatory.

Justice Stewart in the second dissenting opinion declared that the two-cent rate act violated no contract between the state and the railroad; and Justice Potter says that the evidence has not shown that a flat rate of two cents would prevent a fair return upon the capital invested by the railroad. Justice Potter agrees with Justice Mestrezat that the company's revenues from all sources should have been included when considering the question of reasonableness of the rate. (The lower court had decided that the reduced rate would not produce a fair interest on the capital invested by the Pennsylvania in passenger facilities.)

There is a report that the road will put into effect the old rate, but no definite announcement has been given out.

Attorney General Todd, who made the principal argument in support of the act, says that the matter is ended. No appeal can be taken to the United States Supreme Court. Mr. Todd said further: "The court has merely affirmed the judgment of the lower court in granting an injunction against the enforcement of the law against the Pennsylvania Railroad. It refused to pass on the question of the constitutionality of the law. Two points were raised by

the railroad: The first that, under its contract rights, the legislature could not compel it to carry passengers for less than 3 and 3½ cents a mile, the amount specified in its charter; the second point was that it could not be compelled to carry passengers for so low a price, which, it contended, would mean a loss. The court refused to decide the question of contract right, but passed upon the other question merely; so that the law remains in force against all other railroads in the state."

The two-cent fare law was enacted by the last legislature, the bill passing both houses by a practically unanimous vote. The railroads fought the bill vigorously, and after it became a law the Pennsylvania Railroad instituted suit in the Common Pleas Court of Philadelphia restraining the County of Philadelphia from enforcing the law. The court sustained the company's contention. The County of Philadelphia then took the case to the State Supreme Court. Other railroads brought similar action in several counties of the State.

The Trials of a Master Mechanic.*

The problem of engine failures to all of us is synonymous with, "please explain," "can you tell us why," etc., and all the attending evils—briefly, the handling of an amount of correspondence which would be staggering to a layman. It requires a cool, well-balanced head, either to interrogate the engineer or to subsequently present the explanation on an acceptable basis to the superintendent of motive power, who as a rule is equally well-versed, if not sharper, than yourself. Some of these things are knotty in the extreme. For instance, two minutes are lost on a certain important run, account of low steam: should we say it is "up to the fireman," they would probably tell us to take him off, or question our judgment in using an incompetent man; if we state "blower-pipe tipped over," or "exhaust base leaking," we are called upon to explain why we despatched the engine in that condition; if we claim that the engineer is incompetent, or did not take proper advantage of his opportunities, and discipline him in accordance with our ideas concerning the gravity of the offense, he will point to his 20 or 25 years' successful record, and no doubt send his committee after us; should we on the other hand fall back on the time-honored and time-worn "bad coal," the superintendent of motive power, if he is on to his job, and he generally is, will likely come back, asking us to state definitely wherein the coal is bad, in other words how much slate, sulphur, bone, ash and other inert substances figure in its composition.

Explanations of engine failures truly place a man between Scylla and Charybdis, because the middle ground is restricted to a degree, and once or twice worked over there is no more to it. Some of the explanations would make a dead man turn over in his grave, to wit: "This failure was due to an old concealed defect, which could not be detected in an ordinary roundhouse inspection"; another, "Owing to a high northwest wind which prevailed while the engine was being sanded some particles were blown into the truck box, resulting in delay of ten minutes from box heating, subject of your letter such a date"; and still another, "Pipe to auxiliary reservoir, engine 2,397, failed, causing delay of 27 minutes. This failure was due to pipe being short-threaded, and was a builder's defect of a concealed nature. This part has never been removed since engine was received here."

A great many of these explanations are soundly based on fact, but many are not so. To handle the matter intelligently an observant man will make each case an object lesson, and will insure, so far as his facilities will permit, against its recurrence. Sometimes letters come from up the line stating that "bad coal" will no longer be accepted as an excuse, but this does not alter the fact that very often the coal is bad, in the broadest acceptance of the term, and the best thing to do then is to read up thoroughly on the subject and try to prove it—if you can.

Having to do with the coal problem, one of a master mechanic's trials, and certainly not the least, is for the rumor to go broadcast over the division that the fuel is not up to the standard; and it requires many days, if not weeks, to swing the firemen back into line. Some of my most exacting days have been spent in missionary work among the latter, preaching always from one text, "Fine coal does not necessarily mean bad coal." Logical and scientific arguments, coupled with practical demonstration, sometimes turn the trick, but a number always remain outside the fold.

Some engineers are prone to resent any questions regarding an engine failure, and patience and tact are both requisites to secure the facts. "Why, that was only a minute," some of them will say, and they don't seem to grasp the idea that just as long a letter is required to explain one minute as 20. It is only fair to add, however, that to a man they fight hard to keep a delay off the run slip, and this is all the more commendable in view of the fact that it is exercised irrespective of any feeling which they may have against the master mechanic or the shop. I cannot recall a case in my entire experience where a delay was wilfully brought about.

Under a divisional organization the superintendent is practically general manager in his own territory, and the master mechanic will be sorely tried if he fails to gain his good opinion on the very start. Primarily the superintendent wants his trains to run on time, and, just as important, he wants power to move them when a movement is necessary. Thus is brought about another complex situation with which many of us have contended. A man could never be placed more curiously between two fires than in trying to please both the superintendent and the motive power department, when the freight movement is heavy. The natural inclination of the master mechanic is to keep peace at home, and to this end he turns the power as fast as possible. If it runs down, he will likely fall into disrepute with the general offices; while on the other hand if he holds the engines in and painstakingly and thoroughly does all the reported work, a lament will go up from his own people in regard to slow movements from the roundhouse. This situation requires the middle ground again, and all the common sense, judgment and diplomacy you can ram into it.

Engineers with an imperfect understanding of what is meant by a divisional organization are inclined to criticise the authority of the superintendent to assign the power, claiming that this belongs properly to the master mechanic. They also blame the master mechanic for not taking the business in his own hands. In my own case I was very fortunate in having a superintendent who simply insisted on the best possible train service, and was more interested in the results than in the means employed to reach them. To digress a little, this man truly had the so-called knack of handling men, and certainly understood the true meaning of a divisional organization. We all knew, however, that he meant every word he said, and we were very anxious to please him, as he did not consume time in exploiting trivialities which might be much better employed at something else. I can't exactly say why suiting the superintendent should be thought a trial. I have found that if a man will make the honest effort to do all that his resources will permit, the superintendent will come to his aid more frequently than he will be censured.

The question of providing for material is probably as vexatious, if not more so, than the engine failures. There is certainly no greater trial for any man's patience than to have a bunch of orders returned to you every day, marked "not in stock." Always it is something of which you are in the greatest need. In particular, the locomotive equipment is a serious problem. I venture to say that with possibly two or three exceptions this matter of keeping supplies on locomotives is nothing more than a bluff or a farce.

This situation is extremely embarrassing to a master mechanic, and too often a temporary remedy is sought in robbing one engine for another; and I may as well say now, that this thing once started, it never stops. I have known an engine to be laid in about two weeks waiting for some minor casting, and to be so stripped in that time, owing to storeroom shortage, that scarcely more than the boiler and wheels remained.

The extremes to which a man may be driven would scarcely be credited. I worked for one road some years ago which possessed more than its share of able-bodied requisition slashers. It was not out of the accepted order of affairs to see an engine go out on an important passenger run with a lantern stuck up in the headlight case in lieu of an interior. When an engine would come on the ash pit a gang of men would be waiting to remove the grease-cup plugs, coupler knuckles, headlight reflector, and occasionally the air hose, with which to get something else into service. Even the fire hooks and shovels, especially the latter, ran first in, first out, and when they began chain-ganging the tanks and reverse lever latches, I left for a place where the pay was less but things were not quite so strenuous. This was the only instance in my career when I voluntarily threw up the sponge. This same road, by the way, also ran out of nuts. They had plenty, of course, 2½ and 3 in., which would have filled the bill all right in some marine engine works, but none of the common sizes, seven-eighths or inch. In consequence a machinist at 30c. an hour would spend half a day rooting in the scrap pile, and the other half tapping the few nuts he was lucky enough to find. The entire situation was distressing in the extreme.

From my experience all roads are short in locomotive equipment. The majority have a system of tool inspection and accounting beyond criticism, but it is an almost impossible task to live up to the requirements. The situation may be held within reasonable bounds when the engines are assigned to regular crews, but it is practically hopeless in the pool. The engineers do not stop short of the master mechanic in filing complaints along this particular line: "Mr. So-and-so, I have a hammer and a broken chisel on my engine, and no monkey wrench. I will go out if you say so, but I will not be responsible if I have to disconnect." What are you going to do in that case? Time may be pressing; perhaps he should then be on his train. You try the storehouse, and they have

*From a paper read before the New England Railroad Club by R. H. Rogers.

no monkey wrenches. In the last extremity, and to prevent a terminal delay, you order one off another engine, and away goes your tool system.

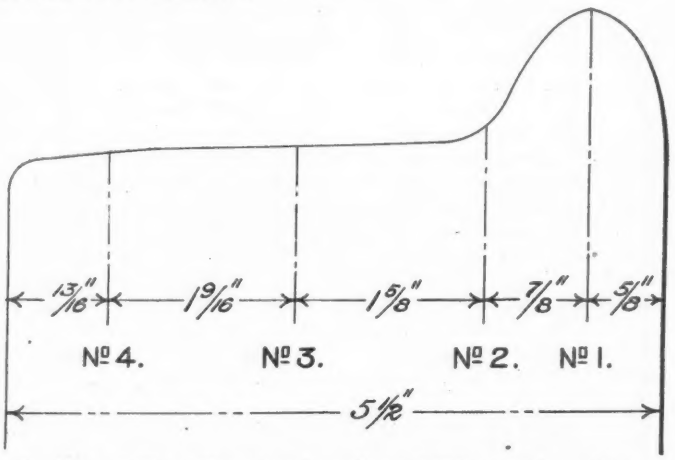
I do not mean to suggest a remedy for this condition, indeed I am not qualified to do so; but take it all in all, it is a menace to the peace of any master mechanic. Although I am naturally of a stoical and rather optimistic temperament, it has cost me many anxious hours.

Microphotographs of Steel Wheels and Tires.*

BY GEO. L. FOWLER.

(Reprinted from volume of reports made to the Schoen Steel Wheel Co.)

The physical properties of the steel in these wheels and tires having been determined, an examination with the microscope was made of samples from each. In the preparation of the specimens for this work strips were cut from each wheel and tire in accordance with the lines shown on the diagram. The numbers 1, 2, 3 and 4 are for the identification of the strips and are used in connection with the photographs, all of which were made with a magnification of 88 diameters.



Section of Tire, Showing Location of Microphotographs.

Referring first to the microphotographs of the D tire, Nos. 1 to 6. Nos. 1 to 5 were taken in strip No. 4, at the tread and at ⅛ in., ¼ in., ½ in. and 1 in. below the tread, respectively, and No. 6 at 1 in., below the tread in strip No. 3. These photographs show an exceedingly fine granular structure, indicating careful heat treatment, a low average percentage of carbon and an abundance of ferrite. The structure becomes somewhat coarser as the metal is penetrated and the normal structure is reached at a depth of about 1 in. It will also be seen that there is a slight difference between the structures of the metal as illustrated by the two photographs Nos. 5 and 6 which were taken at a depth of 1 in. below the tread in strips 4 and 3 respectively. No. 5 is the finer, showing that the metal received more work at that point than it did deeper in on strip No. 3. This D tire had the finest grain and the most uniform structure of the samples examined. On the other hand, the photographs corroborate the chemical analysis of low carbon content, possibly down to 0.50 per cent. as indicated by the proportion of ferrite (white) and pearlite (black).

Next in order of fineness of grain comes the C, B and A tires respectively. Here again the relative amounts of ferrite and pearlite give an approximate indication of the amount of contained carbon from which it would appear that the B and C tires would not run over 0.60 to 0.65 per cent. while the A may rise to 0.70 per cent.

The material of the B tire shows a practically uniform texture of grain throughout its whole depth, with no decarbonization at the tread due to heat treatment, although this is undoubtedly due to the tire having been turned before being examined.

In the C tire, which was new, it will be seen that the outer layer of the material next to the tread, as indicated by the photograph No. 7, was decarbonized by the action of the heat treatment to which it was subjected. The presence of ferrite is very marked all the way across the tread, but below the surface, as indicated by the photographs Nos. 8, 9 and 10, which were taken at depths of ⅛ in., ½ in. and 1 in. below the tread respectively, the grain assumes the normal condition for the steel at its finishing temperature, although it is somewhat finer at the edge strips Nos. 1 and 4 than in the center strips Nos. 2 and 3, indicating failure of the work to penetrate the center.

The A tire has such a high carbon content that the absence of excess ferrite causes the grain to become obscure; it was possible to bring the formation out in part only by oblique illumination. When viewed under the microscope with the light adjusted to the best advantage a decided coarsening of the grain is noted at suc-

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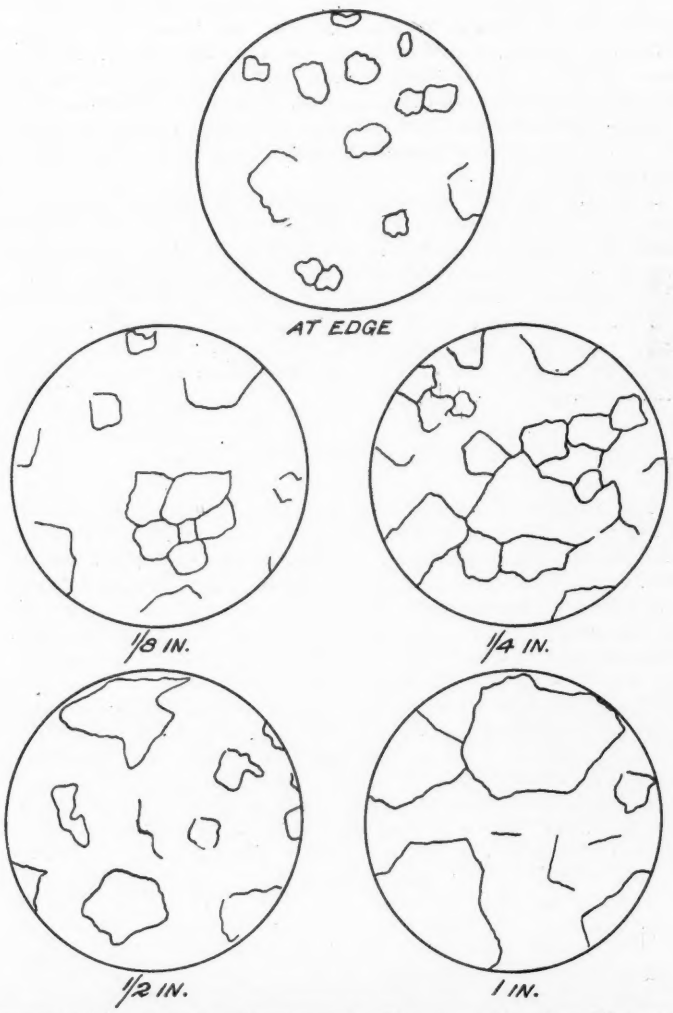
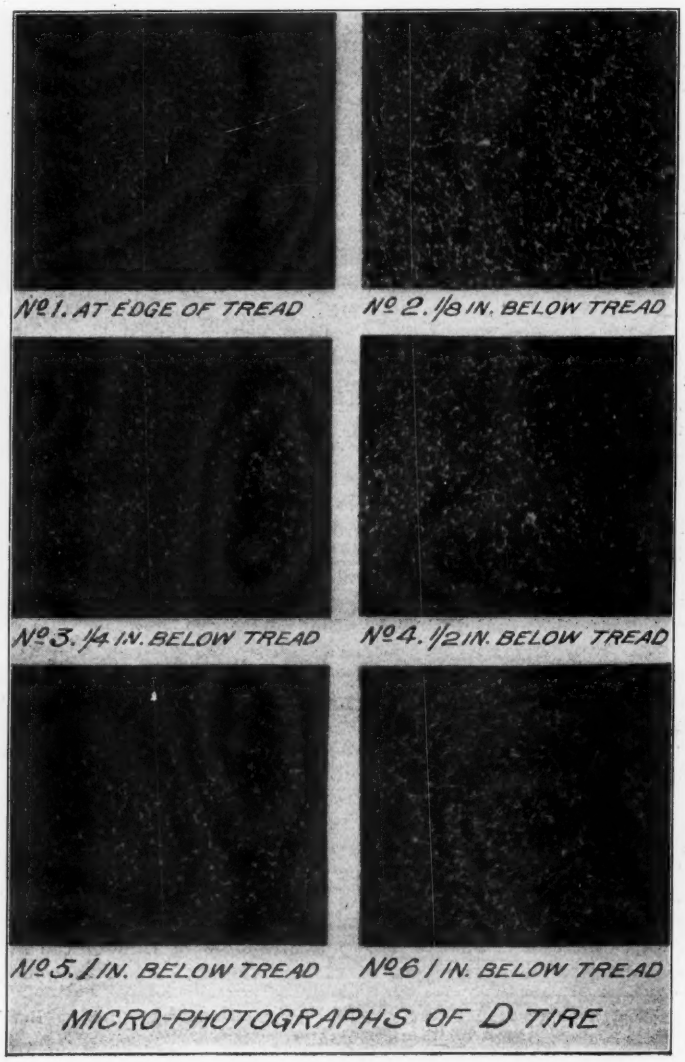
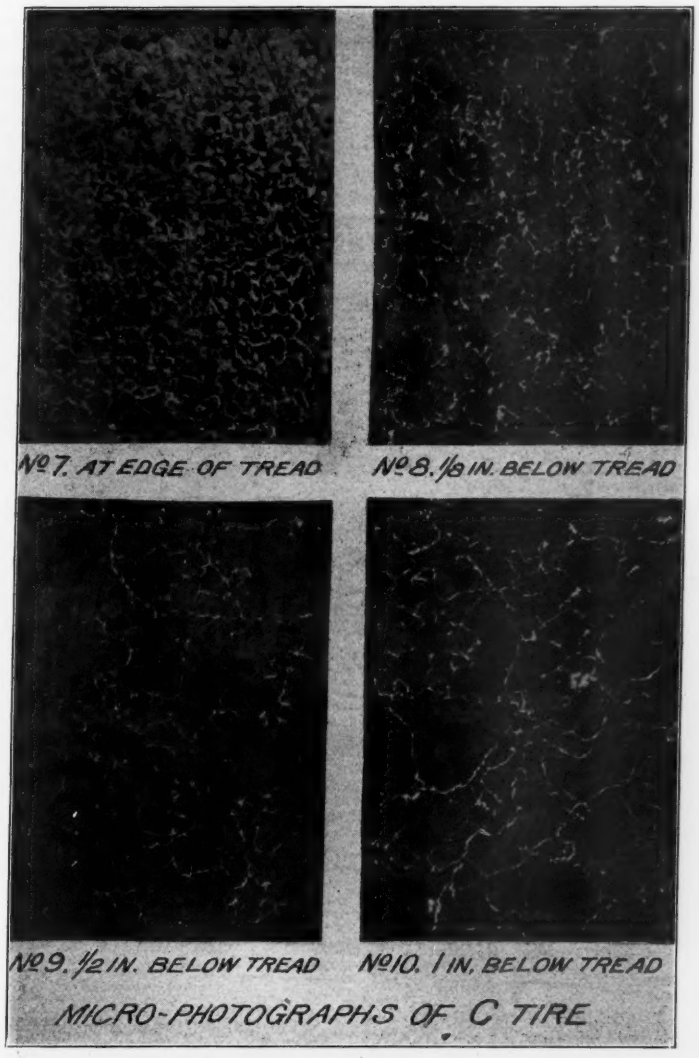
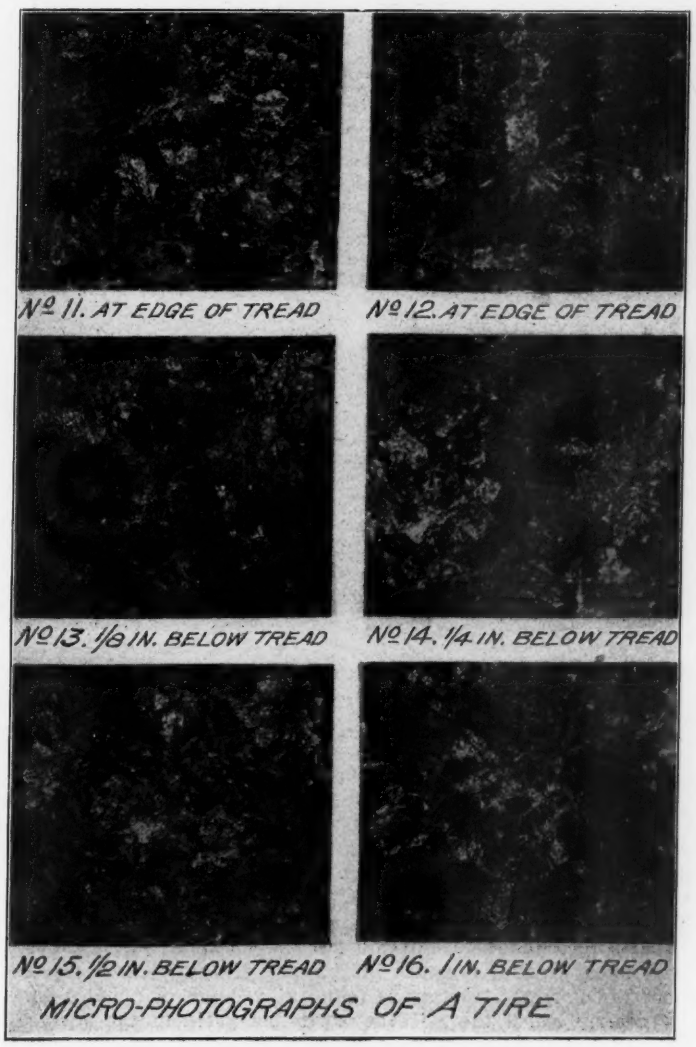


Interpretation of Grain Structure in Tire A at Varying Distances Below Surface of Tread.



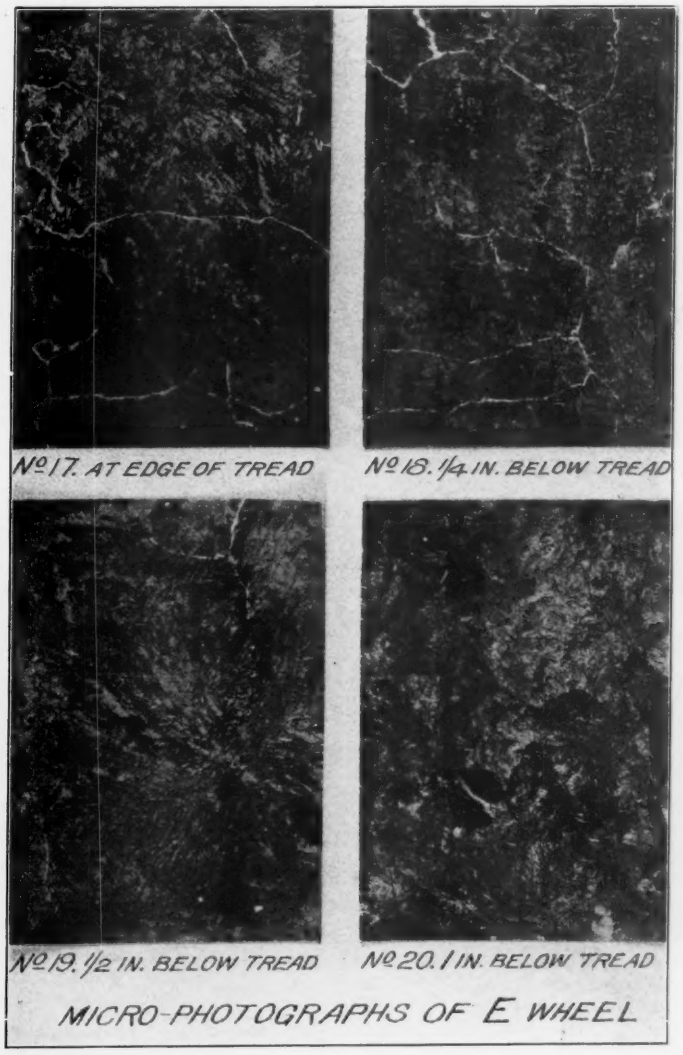




cessive points below the tread. For example, at the surface the grains are apparently about the same size as those immediately below the decarbonized shell of the tread in the C tire, but the grain coarsens rapidly and at a depth of 1 in. it is somewhat coarser than that of the C tire. The structure is interpreted from the micro-photographs in the accompanying diagram made at the same magnification.

The E wheel has an exceedingly coarse structure with traces throughout of inequality of carbon content and disappearance of the grain. This is especially noticeable in photographs Nos. 19 and 20 and appears in the others to a greater or less extent, showing an unevenness of structure that is suggestive of cast steel. This is discussed elsewhere in connection with a shelled-out wheel of the same make. The penetration of work was apparently very slight as is shown by the large size of the grains in No. 17, taken at the surface of the tread, and the increasing size of structure as shown in Nos. 18, 19 and 20 taken at depths of ¼ in., ½ in. and 1 in. respectively.

The F wheel has a coarser grain than the A, B or C tire and is slightly coarser than that of the D tire. The carbon content appears to be about the same as that of the C tire or somewhat above

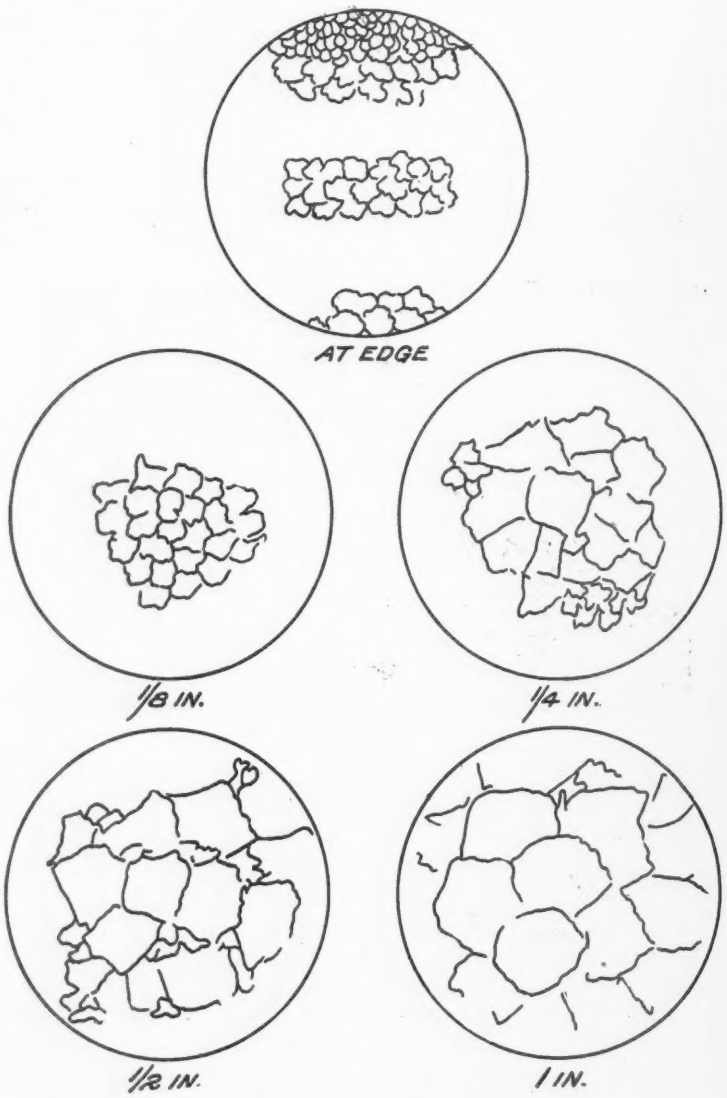


0.60, and this is checked by the chemical analysis. The surface decarbonization which is so marked in the case of the C tire appears in this one also, as indicated by the increase of the amount of ferrite accompanied by softening of the surface. The large size of the grain in this wheel, as illustrated by photographs Nos. 21 to 26, is caused by the peculiar heat treatment to which this wheel was subjected, as there is no work put upon it after the final heating. This also explains why there is comparatively little enlargement of the grain going down from the surface of the tread. The photograph No. 21 was taken at the surface of the tread and the others followed at depths of ⅛ in., ½ in., 1 in., 2⅛ in. and 2⅜ in. respectively.

The B tire is typical of the others and needs only a word of explanation of the microphotographs Nos. 27 to 30, which were taken at the surface of the tread and at depths of ⅛ in., ¼ in. and ½ in. respectively. From these the gradually increasing size of the grain is apparent, though from its large dimensions, even at the tread, it would appear that this particular tire was finished at a rather high temperature.

The microphotographs of the Schoen steel wheel show that for the first ⅛ in. of depth it has the finest structure of any of the

wheels and tires examined, but below this depth its grain increases in size in a comparatively uniform manner, though with a variation to be noted later, until, at a depth of 1 in., it is slightly coarser than any of the tires. On the other hand, it contains but a trace of ferrite, indicating that the carbon content is about the same as that in the A tire. Here again, owing to the absence of sufficient ferrite to outline the grain clearly, it was necessary to photograph by oblique illumination, and it was under this light that the accompanying sketches to show the grain's size were made. The microphotographs closely check the abrasion tests and the determinations of specific gravity.



Interpretation of Grain Structure in Schoen Wheel at Varying Distances Below Surface of Tread.

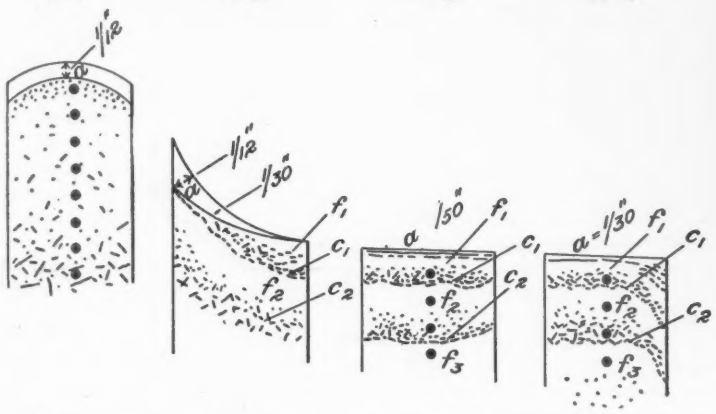
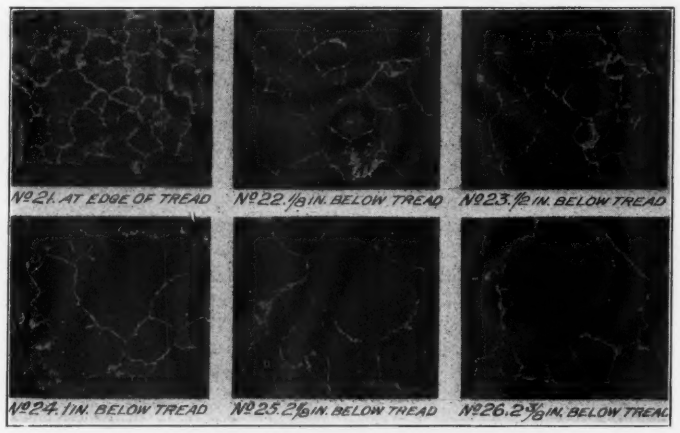


Diagram Illustrating Grain Structure of Schoen Steel Wheel.

There are two well-defined zones in the rim of the Schoen wheel, that are evidently due to the rolling. One is at a depth of ⅛ in. and the other ⅜ in. below the surface of the tread. This is best illustrated by the accompanying diagram of the microstructure in the Schoen wheel, in which the four strips and the location of the microphotographs are roughly indicated.

Strip No. 1 shows a very fine grain at the surface with carbon well below 0.50 per cent. This structure runs down for about $^1/_{21}$ in., where there begins a gradual increase of the grain size until the normal dimensions are reached at about $^1/_{12}$ in. below the top of the flange. The first $^1/_{24}$ in. is formed of a very fine mixture of about equal proportions of ferrite and pearlite, and below this the ferrite gradually disappears and the grains increase in size. At a depth of $^1/_{12}$ in. the ferrite appears as a discontinuous band or envelope around the grains of pearlite, indicating that the carbon content is about 0.70 per cent. This increase in the size of the grains continues downward until they reach their maximum at a depth of about 1 in.

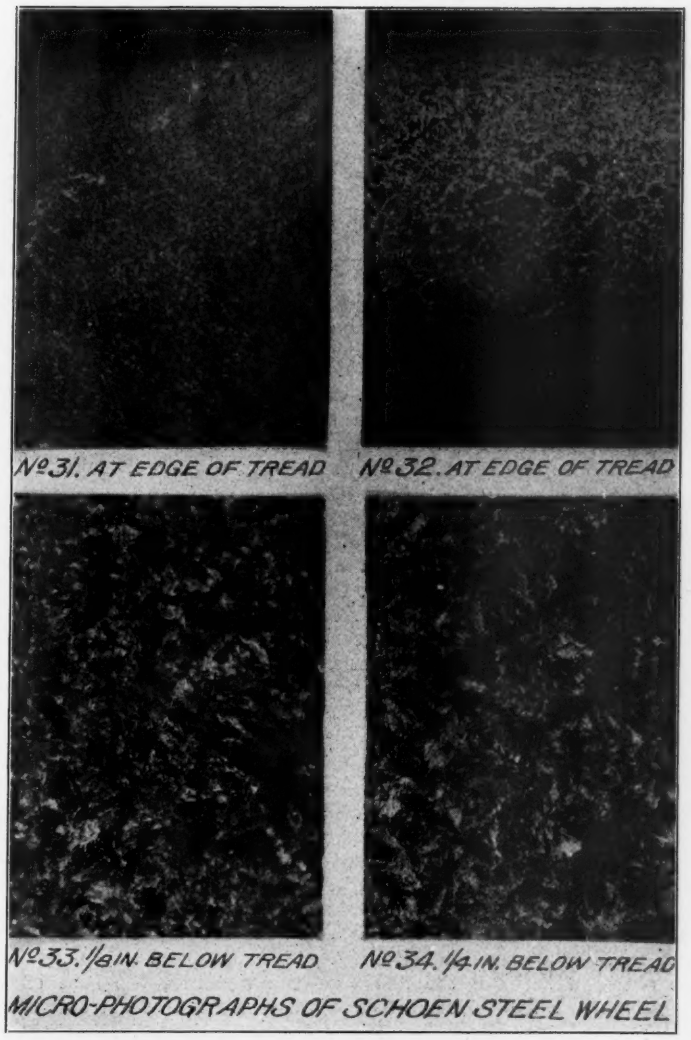
In strip No. 2 there is the same fine-grained surface structure



Microphotographs of F Wheel.

(*a*) corresponding to that of No. 1. The depth of this decreases from one side of the strip to the other and is about $^1/_{30}$ in. thick at the corner. This structure is shown in the photograph No. 31. On the right hand side, two zones will be seen; one of which, starting at *f*1, is of very fine pearlite. The point of maximum coarseness is at *c*1. This is not really a coarse grain in itself, for it is fine even when compared with that of the D tire. Below *c*1 there is an abrupt change to extreme fineness again at *f*2. This is followed by a gradual increase in the size of the grain down to *c*2, where the normal structure is found at a depth of about 1 in.

In strip No. 3 there is the same fine grain at the surface, as



MICRO-PHOTOGRAPHS OF SCHOEN STEEL WHEEL

MICRO-PHOTOGRAPHS OF SCHOEN STEEL WHEEL

shown in the photograph No. 32, which extends down to a depth of about $^1/_{50}$ in. The extreme outside shows almost entire absence of carbon, or nearly pure ferrite. This is followed by a gradual increase in the amount of carbon until, at a depth of about $^1/_{50}$ in. a fine grain structure almost wholly of pearlite is indicated at *f*1. Next comes a uniform increase in the size of the grains, until they reach their maximum at the point marked *c*1, where there is an abrupt change to a structure of great fineness, which, in turn, increases in size to a maximum at *c*2, when there is a second abrupt change to extreme fineness at *f*3. Below this there is a gradual increase in the grain size until the normal structure is reached at about 1 in.

In strip No. 4 there is the same decarbonized outer layer (*a*) which is about $^1/_{30}$ in. thick at the center, thickening towards the right in the direction of the edge of the wheel rim. This structure differs in appearance from the corresponding area in No. 3 due to the distortion of the grain by mechanical treatment of the metal after ferrite or pure iron became excessive as the result of burning out the carbon on the surface of the steel. The size of the grain increases from fine at *f*1, to a maximum coarseness at *c*1, ⅛ in. below the surface where there is the same abrupt change as before to a fine structure at *f*2. This will be seen by a reference to photograph No. 38. The grain again increases to a maximum coarseness at *c*2, with another change to extreme fineness at *f*3, at a depth of about ½ in. Beyond this point the grain increases uniformly until the normal size is reached at a depth of 1 in. as indicated by photograph No. 36, and the diagram of grain sizes.

These changes in grain size are accounted for by the successive heat and mechanical treatments to which the Schoen wheel was subjected.

The conclusions drawn from this work with the microscope are practically the same as those reached by a study of the physical and chemical tests. It is apparent that the Schoen wheel is quite equal to the best tires, as regards depth of finish and the fineness of the grain in the steel.

Influences Affecting Train Resistances.

C. Carns Wilson read a paper before the Institution of Civil Engineers in London on Dec. 10, 1907, in which he discussed the forms of train resistance formula, and concluded with a resumé of the various causes affecting that resistance and the effects which they produce. They were as follows:

(1) *Journal-friction in its relation to train-resistance and its possible reduction by roller-bearings.*—The real value of roller-bearings in railroad traction is shown to lie in the reduction of running resistance and consequent saving of energy, and not in the reduction of starting-effort. The results of tests with roller-bearings on the Eastern Bengal State Railway show a saving actually obtained of 1 per cent. greater than that calculated by the use of the resistance-formulas.

(2) *The influence of the truck on the resistance of bogie-coaches.*—The resistance of a coach is shown to depend largely upon the wheel-base of the truck, and the relation of the weight of the bogie-trucks to that of the whole coach.

(3) *The effect of electrical driving on the resistance of bogie-coaches.*—The weight of the motors and the extra weight of the motor-trucks in electrically-driven coaches increases the flange action and the total resistance of such coaches. The resistance of electrical motor-coaches is in some cases as much as 54 per cent. greater than that of trailing coaches running at the same speed under similar conditions.

(4) *The reduction of the resistance of goods-wagons by the use of bogies.*—The influence of the bogie on train-resistance is shown to be greatest in the case of goods wagons.

(5) *The relation between the tractive efforts required to haul loaded and empty bogie goods-wagons.*—Since flange-action depends upon the ratio of the weight of the bogie to that of the whole wagon, it must follow that the resistance per ton of a loaded bogie-wagon must be less than that of the same wagon empty. This is a matter of general experience, and can only be explained on the above hypothesis. The results of tests in which a train of bogie-wagons was hauled over a considerable distance backwards and forwards, first loaded and then empty, show that the ratio of the mean draw-bar-pull in the two cases was 0.56. When the resistances are calculated by the formulas, the ratio is found to be 0.62.

(6) *The incidence of train-resistance on flange and rail-wear.*—The energy expended in overcoming flange-resistance is represented by the wear of tires and rails. This wearing action is much greater in some cases than in others.

(7) *The reduction of flange-action by mechanical contrivance.*—It is shown that by giving the bogie a lead, as is done in Timmis' bogie-lead, the flange-action of the bogie can be reduced, and that the saving depends upon the ratio of the bogie wheel-base to the distance between the bogie centers, and also upon the ratio of the bogie weight to the total weight.

(8) *The effect of side play on train-resistance, and its possible*

limitation.—The amount of play between the flanges and the rails is an important factor in train-resistance. The want of uniformity in current railroad practice in this matter is illustrated by the amount of side play adopted on different railroads in Great Britain, in the United States, and on the Continent. The increased resistance and wear occasioned by large flange-play suggests the importance of a reduction of the play to a standard ⅜ in. as on the London & South-Western and other railroads.

(9) *The relative importance of air-resistance.*—The resistance of the air with a train of bogie-coaches, running at 60 miles per hour, amounts to about one-half of the total tractive effort required to haul the train. The experiments conducted by the St. Louis Electric Railway Test Commission show that a large reduction can be made in the front and rear air-resistance by shaping the ends, and that by this means a saving can be effected of 10 per cent. of the total tractive effort with a long passenger train, and 30 per cent. with a single coach.

The Car Wheel and Its Relation to the Rail and Car.*

In going back to the period of the 24,000-lb. capacity car, and comparing it with the present 100,000-lb. capacity car, the increase in load capacity is 76,000 lbs.; increase in tare weight, formerly 18,000 lbs., now 42,000, is 24,000 lbs.; increase in permitted excess load, 10 per cent., formerly 2,400 lbs., now 10,000 lbs., or 7,600 lbs., making a total increase which the eight wheels of the car have to carry, of 107,600 lbs., which is 240 per cent., or 3.3 times as much load.

The wheel used under a 24,000-lb. capacity car weighed 525 lbs. and the wheel used now under a 100,000-lb. capacity car weighs 700 lbs., an increase of 175 lbs., or 33 per cent. The brake pressure applied to the eight wheels of a car was formerly 12,600 lbs. and at the present time is 30,000 lbs., an increase of 138 per cent. In addition to these changes, there have been other changes that have had a material effect upon the service, viz., greater rigidity of car trucks and car bodies, higher speeds, and a general introduction of the air brake, involving a much greater and more general absorption of energy at the periphery of the car wheel. It thus appears that the work generally imposed upon the wheel in service at the present time is very much more severe than formerly, and in this there seems to be little opportunity for disagreement.

I might state here that during this period between the general use of the 24,000-lb. capacity car and the introduction of the 100,000-lb. capacity car, the requirements of the cast iron wheel imposed by railroads upon manufacturers have been made considerably more severe and comprehensive. The time guarantee has been raised from two to four and five and, in some cases, six years. Physical tests of car wheels have been generally imposed, and the thermal test has been added to the drop test. The increased exactions of the railroads in this way have been met by the manufacturers at an actual reduction in price of about 25 per cent.

It has been suggested of late that the cast iron car wheel is no longer equal to the conditions imposed by modern service, unless a very material improvement in quality can be obtained, which no one has thus far been willing to suggest as probable, but it does not follow by any means that such a thing is not possible. While the question of improving the quality to meet these new conditions is under consideration, it occurs to me that possibly other developments might be brought about which would greatly mitigate the difficulties that are being experienced.

The development of the steel car wheel has been taken up actively by several concerns in this country with the idea of providing something to meet the needs of modern service, and there are others who are about to embark in this line of work. They have received a good deal of encouragement, and there are those who believe that the real remedy for the present difficulties lies in the use of steel instead of cast iron. Steel has many qualities that commend it for the purpose, but I do not think it is going too far to state that the use of steel should not be expected to completely eliminate the present troubles, and that whether or not the steel wheel shall be considered essential and come into more general use, it would appear that it, as well as the cast iron wheel, should be protected, as far as possible, from some of the very trying conditions to which all wheels are now subjected.

The particular failure of wheels that is attracting most attention at the present time is that of the breaking off of the flange. This is not so frequent as might be supposed, but its consequences are often most disastrous; the number of removals of wheels whose flanges might easily break is much larger than the number of those that finally fail in service. In addition to this, I find that of all wheels removed from service, not less than 50 per cent. are removed on account of worn flanges, and in this percentage I include those that are worn away from the flange, usually found on the opposite end of the axle and which cannot be remated. Fifty per cent. is the minimum percentage; the maximum that I have found is 85 per cent. My data for this statement is obtained from four heavy service eastern railroads and two typical western railroads. Taking up first the question of broken flanges, I would state that my conclusions are based on personal observation of a large number of wheels examined on several railroads. Comparatively few broken flanges come from the flange being worn thin and broken off laterally through the smallest section at the base of the flange. By far the larger number come as a result of the development of a seam opened on the tread of the wheel and oftentimes beneath the surface close to the base of the flange, and often before the flange is worn to any considerable extent. Sometimes this seam exists and is not apparent at the surface; in fact, I have seen cases where the seam has existed beneath the surface for some time before reaching it, but in the majority of cases the seam extends to the surface at about the same time. In most of the cases examined it has been noted that the fractured metal has a blue discoloration, an indication of oxydization from heat. In thus stating the facts I am confirmed by experienced railroad and mechanical men and wheel makers. Several explanations for this failure have been made to the writer, but the most logical explanation seems to be as follows:

Fig. 1 illustrates the relation between a wheel with a 25 to 1 taper on the tread and the rail head. This shows the wheel and the rail in their normal relation; that is to say, the wheel occupying its proper gaging position with reference to the rail, and it will be seen from this that the contact between the two is reduced to a very small area, in fact, theoretically it is a point. If the wheel occupies a position such that the flange or the throat of the flange is against the rail, the contact will be changed as shown by Fig. 2, so that the contact will be practically on the tread at the base of the flange. Frequently heavy loads are carried for some time on the wheels in this way, so that under this condition there is an extreme concentration of the load at this point, which is, as a rule, the point at which these seams are developed. At the same time severe application of the brake occurs, the brake shoe bearing heavily on the tread at the base of the flange. Such a combination of conditions as this might occur on a down grade and in passing around a curve. In addition to the heat developed by the brake shoe there is a material increment of heat developed as a result of the abrasion between the flange of the wheel or the base of the flange and the rail. Here, then, is a combination of extreme conditions; in other words, concentrated load and concentrated heat, together with considerable lateral pressure against the flange if the car happens to be passing around a curve at considerable speed.

During the period of the lighter capacity car these same conditions prevailed and occasionally the flange of the wheel failed in the same way as it fails at the present time, but such cases were so infrequent and so much less disastrous in their effect than at the present time that little notice was taken of them. It sometimes occurs to-day under 60,000-lb. capacity cars.

In considering greater frequency of flange failures at the present time it must be borne in mind that the number of freight equipment cars in service has increased very greatly during the last few years and the average mileage that these cars make is very much greater than it used to be—as nearly as I can ascertain about 100 per cent.—and the application of air brakes to freight equipment cars is now universal, so that the increased number of flange failures is readily accounted for, allowing the causes to be practically the same as formerly.

As to the manner, in detail, by which this seam is developed, I suggest the following explanation: The sudden application of heat to the tread of the wheel at the base of the flange has the effect primarily of making the metal at the surface expand quickly. The metal below the surface cannot expand so quickly and so resists the expansion of the surface metal. The surface metal is therefore put under compression while below the surface the metal is put under tension. The one is working against the other with the result that the metal will yield at the weakest section, which would be that part that is under tension. Subsequently, if the conditions prevail for a sufficient length of time the surface will crack also and a thrust against the flange, as in passing around a curve, would remove a portion if not the entire flange. The operation of heat in this way may be illustrated in large metal ingots. It is not infrequently the case that when a large body of hot steel is poured into an ingot mold, that that part of the metal which comes in contact with the metal mold cools rapidly while that at a distance from the surface cools very much more gradually, with the result that, as the surface metal tends to contract and is resisted by the body of metal within, the surface metal, which is subjected to a pull or tensile stress, yields, and a crack or check develops.

This operation is the reverse of that which takes place in the wheel, but the forces at work are identical and operate in the same way. To these conditions brought about by the application of heat, add the concentration of load at the same locality with lateral thrust against the flange, and it would seem strange if failures did not occasionally occur.

The writer has seen flanges of steel tired wheels that have failed

*A paper presented at the January meeting of the Western Railway Club by S. P. Bush, Vice-President and General Manager of the Buckeye Steel Castings Co., Columbus, Ohio.

in the same way as cast iron, but it is a question whether the causes were precisely the same, although it would appear the same causes were largely contributory. Where the load is concentrated as here described it would seem that a peening action must take place to some extent, probably more with the steel than with the cast iron, inasmuch as steel is ductile and there is at times what is generally designated as a flow of metal under pressure. This peening action would necessarily seem to have a considerable influence in the case of the steel wheel, but the chill of the cast iron wheel being so hard, the metal cannot flow as in the case of the steel, but may wear or disintegrate very rapidly if the pressure is extreme. But this peening action, in the case of the steel wheel, and the concentration of heat together with considerable and constant lateral pressures, do not appear as unreasonable causes for the failure of the flanges of some steel wheels. It should be borne in mind that on a straight track a wheel is often running to one side constantly and lateral flange pressure is produced.

I might here call attention to the fact that the chills in which car wheels are cast develop such cracks in the surface in time, as a result of sudden heating and cooling. In fact, it is one of the chief reasons for the discarding of chills and the requiring of renewals. It is not at all an unusual thing for heavy castings to crack in a foundry as a result of internal stresses caused by a difference in temperature between the surface of the casting and the metal within. In fact, the process of annealing is for the purpose of preventing very large internal stresses which might cause failure in use, and the practice of soaking wheels or slowly cooling them is provided for the purpose of eliminating internal stresses.

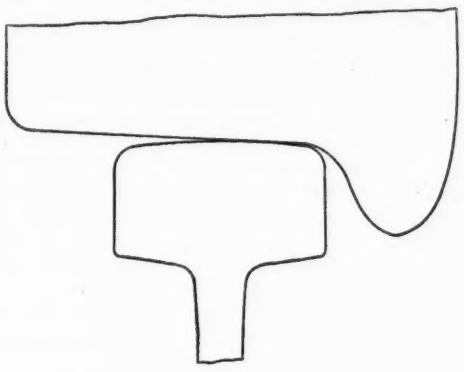


Fig. 1.

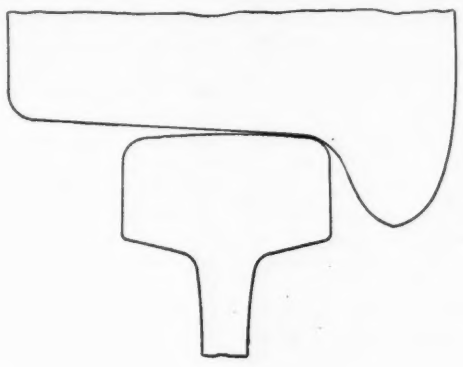


Fig. 2.

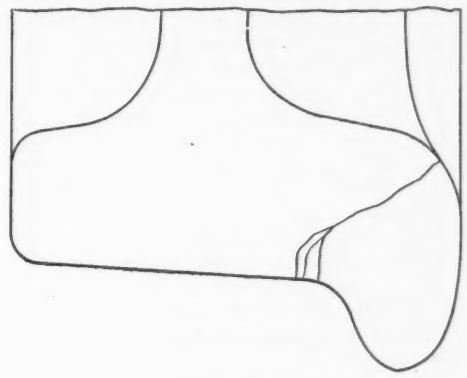


Fig. 3.

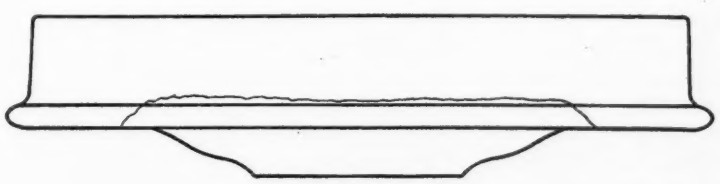


Fig. 3 A.

I present some samples of broken flanges which are typical of the failures that I have described. I desire to lay particular stress on the fact that that part of the fracture which exists at the base of the flange extends vertically for a considerable distance into the tread, as shown in Figs. 3 and 3A. If the flange itself were not sufficiently strong to successfully resist the lateral thrust it would seem that the fracture, instead of going vertically down into the tread, would go transversely across the base of the flange. There are comparatively few cases that have come to my notice where the fracture has been transversely across the base of the flange. In nearly all such cases that I have examined the flanges have been worn thin vertically and the wheel should not be held responsible.

One prominent car builder with whom I have talked in connection with this matter expressed a belief that at points where these seams develop there is already an internal stress which might be considered a seam in embryo, and one manufacturer of cast iron wheels suggests that this might occasionally occur, depending upon the conditions of manufacture and particularly depending upon the rapidity of pouring and the temperature of the metal.

The superintendent of motive power of a very prominent railroad that removes from service a large number of seamy wheels states as follows: "The most serious cause for flange failure is the development of seams at the throat of flange and subsequent breakage. We consider that these seams are the result of concentrated load and heat in combination with poor quality of wheels. We believe that the discontinuance of the use of the proper proportion of charcoal pig iron, together with the inauguration of the thermal test and the more liberal use of ferromanganese in connection with the inferior wheel mixture has had more to do with the development of seams at the throat of flanges and the breakage of the latter than any other items."

As has been said, the fracture in the case of flange failure starts in a vertical rather than a horizontal direction, as shown in Fig. 3. The thickening of the flange in a horizontal direction will not therefore materially assist in the elimination of this trouble. In considering this matter I think it is generally felt that the flange of the cast iron wheel is weak, possibly too weak to perform the service required, but in the light of my investigation I cannot see that such a conclusion is fairly reached.

This particular question was of sufficient importance to one railroad to enlist the interest of Purdue University in making some tests for it with a view of determining the pressure required to remove a piece of flange as if it were in contact with the rail. The wheels were mounted on a suitable support under a heavy service press and the ram of the press was brought down on the flange until the latter gave way.* Three of the wheels tested were taken from service under 100,000-lb. capacity cars after having been in service about eight months. A number of others which were tested had not been in service. In all, 23 tests were made, the results of which are shown by the following tabulation:

Results of Flange Tests.

No. of test.	Breaking load.	No. of wheel.	Point of application of load on flange.	Remarks.
1.	52,850	H. 19,413	Between brackets.	
2.	47,750	H. 19,413	Opposite bracket.	
3.	49,350	H. 19,413	Between brackets.	
4.	53,400	H. 19,413	Opposite bracket.	
4a.	105,000	H. 19,413	Load applied on rim.	No fracture.
5.	62,850	H. 19,410	Between brackets.	
6.	48,700	H. 19,410	Opposite bracket.	
7.	58,250	H. 19,410	Between brackets.	
8.	58,000	H. 19,410	Opposite bracket.	
9.	74,850	H. 19,254	Between brackets.	
10.	72,200	H. 19,254	Opposite bracket.	
11.	87,000	H. 19,254	Between brackets.	
12.	68,550	H. 19,254	Opposite bracket.	
13.	99,300	A. C. & F. Co. wheel 650	Between brackets.	
14.	100,000	A. C. & F. Co. wheel 650	Opposite bracket.	
15.	105,900	A. C. & F. Co. wheel 650	Between brackets.	
16.	68,200	A. C. & F. Co. wheel 650	Opposite bracket.	
17.	79,350	A. C. & F. Co. wheel 650	Opposite bracket.....	Wheel broke through rim.
18.	52,300	H. 19,558	Between brackets ...	Broken wheel; one-half submit'd for test
19.	111,600	1904 M. C. B. pattern (Tape 1) 700	Opposite bracket.	
20.	87,000	1904 M. C. B. pattern (Tape 1) 700	Between brackets.	
21.	109,900	1904 M. C. B. pattern (Tape 1) 700	Opposite bracket.	
22.	98,900	A. C. & F. Co. wheel (Tape 2) 700	Opposite bracket.	
23.	98,900	A. C. & F. Co. wheel (Tape 2) 700	Between brackets.	

From this it will be seen that the minimum load was 47,700 lbs., maximum 111,600, the average about 60,000 lbs. In the case of wheels that have been in service for some time it is probable that the average would be less than this.

The strength of the flange of the steel wheel made by the Schoen Steel Wheel Co., tested at Purdue University with the same apparatus, showed that a pressure of 526,612 lbs. was necessary to remove a piece of the flange. This would indicate that the strength of the steel flange was over eight times that of the cast iron, but as I have stated, the flanges of steel wheels sometimes fail, also indicating that lateral thrust is not likely to be the primary cause of such a failure, although it may be the ultimate cause.

Geo. L. Fowler has recently written for the Schoen Steel Wheel Co. a very interesting publication on the subject of the steel wheel and makes comparisons with the cast iron wheel.† His arguments are based on the belief that the failure of flanges

**Railroad Gazette*, Sept. 15, 1907, p. 591.
†*Railroad Gazette*, Dec. 20 and 27, 1907; Jan. 3, 1908.

is primarily and ultimately due to pressure alone, but in this I cannot agree with him. The evidence that I have collected thus far indicates that the number of cases of flanges broken as a result, primarily, of lateral thrust is almost negligible, and that the other causes already described are more likely to be the real ones. He points out, however, and very truly, that the lateral thrust between the flange of the wheel and the rail is oftentimes very considerable, and he has taken great pains to determine accurately just what the lateral thrust is. He has made an exhaustive series of experiments on the Pennsylvania Lines West of Pittsburgh with an apparatus designed by himself, for carefully measuring the lateral thrust in the case of moving cars or trains passing around curves.‡ His measurements were taken at the outer rail near the end of a 4 deg. 25 min. curve, or a radius of 1,307 ft., the elevation of the outer rail being 3⅞ in., which, as he states, is correct for a speed of 36.66 m.p.h. Most of his results are obtained from a single car allowed to run alone around these curves at different speeds. At a maximum speed of 30.60 m.p.h. his maximum pressure recorded 12,865 lbs. No doubt the lateral thrusts considerably exceed these figures at times, in fact there can be no doubt about it. I am fully convinced that they do, and have seen evidence within the past 30 days to indicate that such is the case. I have seen a number of arch bars, 1⅛ in. x 5 in. material, used under 100,000 lb. capacity car trucks bent laterally ⅜ in., not as a result of wreck or derailment but extreme service conditions. I was told at the time I was shown these bars that similar cases are found from time to time. The cars under which these trucks were used were of very rigid construction, both body and truck, and such evidence as this, together with the information presented by Mr. Fowler from actual measurements, should, I think, confirm anyone in the belief that in the designing of modern cars this item has been greatly neglected.

When the new M. C. B. axles were designed a very important item of allowance was made on account of lateral thrust which attention seems to have been given the matter of the application of brake shoes to the wheels in the way of preventing the concentration of heat at the throat of the flange. When new brake shoes are applied to new wheels it is almost generally the case that the bearing is at the throat alone, and in the case of worn wheels at the throat and the outer portion of the tread. It is often the case also that brakes are so hung that the brake shoes themselves wear into the flange at the throat. I have examined a great many cases of late and find this statement to be entirely correct. When a new wheel is put in service on a new rail, or even on old rails, the bearing between the two would be as indicated in Figs. 1 and 2. As wear takes place, which must be very rapid in so small a bearing, the area of contact increases until finally the coning is all worn off except a small portion near the flange, but the tread of the wheel in time increases its bearing so that 1½ or 2 in., sometimes more, of the width of the tread will be found in contact with the rail. Apparently this is a condition to which it is desired the wheel should come, and it may be said that if wheels are successful in reaching this condition they are likely to continue in successful service giving a normal life unless for some reason there is an extreme condition brought about at some time whereby the heat is concentrated as indicated heretofore. It would appear then, that that portion of the coning which remains is reasonably effective in preventing the wheel from running to the rail. I think it is clearly understood at this time that it is difficult, if not impossible, to mount a large number of wheels on axles and for each two wheels mounted on the same axle to have exactly the same diameter, and the coning, therefore, has for its principal object the equalization of the differences in diameter. The wheel of smaller diameter will have a tendency to run to the flange and the wheel of larger diameter will have a tendency to run away from the flange. In time they seek a level if not prevented from so doing by other causes which will be spoken of later, and accomplish the result desired. I wish here to draw attention to the fact that with such

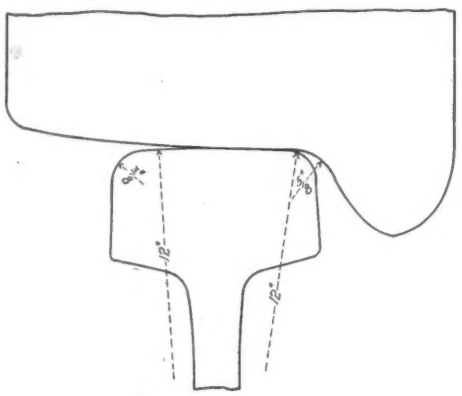


Fig. 4.

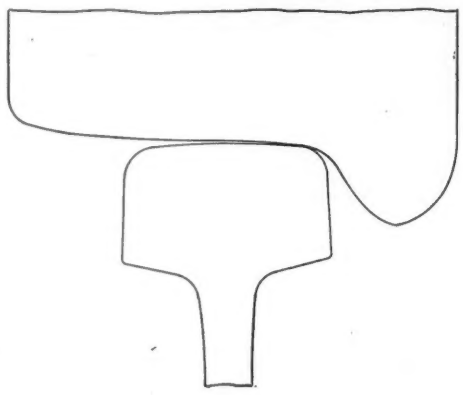


Fig. 5.

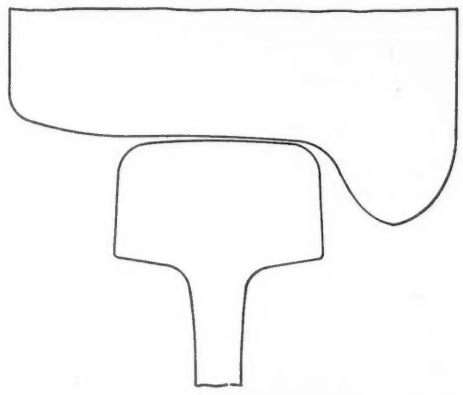


Fig. 6.

reached the axle through the wheel, yet on many railroads, at least, the thought of relieving the wheel has been given little or no consideration. Some railroads have taken this into account and provide in their truck construction for lateral motion or yielding resistance. The old swing-motion truck provided this, and it would seem that some provision for yielding resistance would be highly desirable. Here, I think it is fair to state, that some provision of this kind should not be considered as a complete remedy but as a means for alleviating the difficulty somewhat; in fact, it would seem that a satisfactory provision of this kind would be very material in its effect.

In conclusion on this point, I would state that it would seem that if the flanges of cast iron wheels were not sufficiently strong to stand the thrusts of modern service we would have very many more failures than we do; in fact, to my mind we could not have gone as far as we have in the use of the cast iron wheel. The thickness of the flange has been increased and the limit of wear for the flange has been decreased, with the idea that more strength might originally be had and subsequently maintained. Greater coning of the wheel has been recommended and adopted by some, for the purpose of keeping the flange of the wheel away from the rail as much as possible.

With reference to the increased coning, the consensus of opinion seems to be that it has rendered some assistance in the matter of making the wheels under trucks in service track better or maintain a proper alinement on straight or tangent track. I call attention to the fact, by referring to Fig. 1, that the increased coning has also served to concentrate the load on a smaller area and that, too, closer to the flange of the wheel. It would appear that little consideration has been given the matter of dissipating or distributing the load rather than concentrating it, and similarly little a limited bearing between the wheel and the rail as is shown by Fig. 2, the larger diameter on which the wheel rolls could not be expected to last very long; in fact, it would naturally break down very rapidly and therefore the purpose of the increased diameter might be defeated, particularly if the influence of the greater diameter to turning the truck is not at least equal to the resistance. As a matter of fact, the resistance to turning is probably very much greater than this influence, in many cases, and therefore a wheel may run constantly for a limited period on this larger diameter without accomplishing the purpose for which the coning is intended.

In my judgment it would seem that having reached this working basis by wear, the coned wheels are in far better condition to withstand service successfully than they were when first put into service for the reason that gradually the load is changed from a concentrated condition on a small area of tread near the flange to a very much larger area extending outwardly toward the edge of the tread.

So far as I have been able to ascertain from railroad mechanical men this statement of what I have described as a good working basis is regarded by them as correct; at any rate I regard it as correct. If this working basis that I have described is a desirable one to reach, why should it not be brought into play when wheels are first put into service by making the contour accordingly? From an examination of the treads of a large number of wheels I have obtained a composite contour which corresponds very closely to that shown in Figs. 4, 5, 6 and 7, and it will be seen that this contour bears quite a different relation to the rail from that shown by Figs. 1 and 2. In the former case the bearing is of considerably greater extent, going as a rule beyond the crown of the rail from the flange, and instead of the existence of straight coning, as is originally applied, there is the equivalent extending a short distance from the base of the flange outward and having a radius

‡*Railroad Gazette*, Sept. 15, 1907.

from 1½ in. to 2 in. before meeting the fillet at the base of the flange which is usually worn to 1½ in. or less.

It is my contention that a contour of this kind bears a much better relation to the rail, is quite as effective in equalizing the differences in diameter, has the material advantage of dissipating the load on the rail and wheel tread and makes the wheel more serviceable with less opportunity for failure than would the straight coning of 1 in 20 or 1 in 25 recently recommended and now constituting the practice of the country.

It would appear from the facts as found in service that an increase of the radius of the fillet at the base of the throat beyond ⅝ in. is a positive disadvantage rather than an advantage, inasmuch as in a short time it must be reduced, and provides an opportunity for more extreme concentration of the load on the tread than with the smaller radius. It would appear that a coning beyond this fillet, having some relation to the top edge of the rail so as to avoid extreme concentration of load but which would permit the wheel to roll for a short time on a larger diameter, would be a more effective means of protecting the flange than that at present provided.

In conclusion on this point I do not state that this alone would be a cure for existing difficulties, but I do state that it seems reasonable to me, at least, that it will tend to mitigate the difficulties somewhat if I am right in my premises that it is desirable to dissipate loads on the tread of the wheel rather than concentrate them.

With reference to the matter of improving the quality of the wheel it would seem that after consideration of the conditions under which wheels operate at the present time as compared with formerly, there must have been a considerable improvement in the process of manufacture and in the quality, but it is possible that the larger use of ferro-manganese and the introduction of the

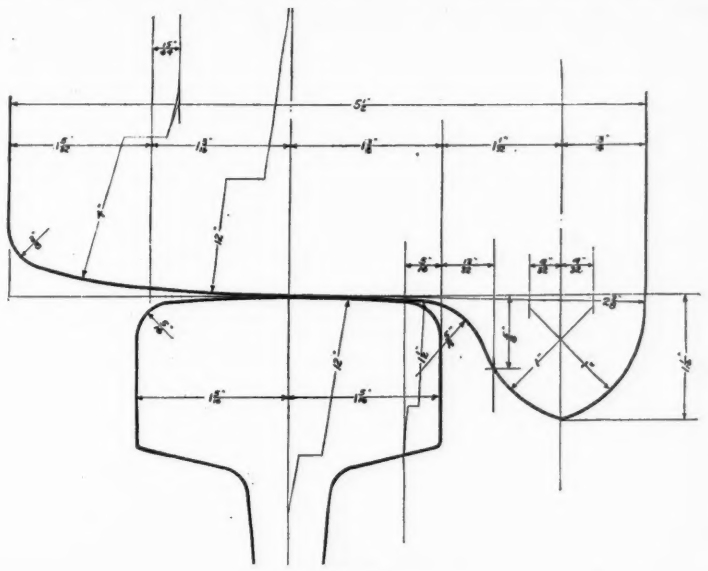


Fig. 7.

thermal tests have contributed to the development of seams in cast iron wheels. The thermal test was introduced several years ago, before the high capacity cars were in general use, to prevent wheels from flying to pieces under severe application of the brake, and in this it seems to have been reasonably successful. If, however, as stated by some, a more general use of ferro-manganese has contributed to our present trouble, no doubt in time this difficulty can be overcome and a more efficient test of wheels might be devised than the thermal test. On this point it would seem that the manufacturers of cast iron wheels might present something that would be helpful.

I have already set forth the greatly increased work required of wheels at the present time. I am of the opinion generally speaking, that unless an improvement is effected in the quality of wheels the failures will be very much more numerous than they are at the present time. If physical tests are of any practical value in determining quality there can be no doubt that the quality is better, although it may be entirely possible that a change in chemical composition such, for instance, as the increased percentage of ferro-manganese used, may have had some effect on the chill whereby it is not so well able to withstand the application of heat.

It is a fact in making slight variations in the chemical makeup of irons and steels that certain relations are oftentimes very radically changed. I can only say that in making my investigations in this direction so little seems to be actually known and so much unknown that this matter must be approached most conservatively. I am prepared to state beyond question, as a result of actual experience in making wheels, that it is entirely possible to produce a cast iron wheel the body of which will be very much tougher and stronger than is the case to-day.

A short time since, wishing to ascertain something about this matter, I made a number of wheels with the idea of eliminating some of the elements that usually make cast iron what it is, viz.: brittle. By greatly reducing the phosphorus and sulphur content I succeeded in making a wheel, the flange and body of which were incomparably stronger than anything that has been commercially produced up to the present time, but I am not at all prepared to state whether the chill of such wheels, if subjected to the conditions of concentrated load and heat at the present time, would withstand existing conditions any better than do the average wheels, although it appears quite probable. It is well known that sulphur is an element that makes for brittleness, yet it also makes for hardness. It is well known that phosphorus makes for brittleness, yet it also makes for red shortness and greatly reduces the strength, but it also increases the fluidity of iron in the melted state and assists in the process of pouring, and it is possible that with a reduction of sulphur and phosphorus content some other element might be substituted which might greatly improve the quality of the chill. There has, however, been little done in the way of investigation along these lines, and I am led to believe that wheel manufacturers have had little inducement to pursue investigations of this kind. I might here state that if an improvement in the quality of the wheels is desired it is absolutely certain that an increase in the cost will be unavoidable. I hope to be able to pursue this phase of the question later, but at the present time it is my desire to point out other possible remedies which may materially alleviate the difficulty of broken and worn flanges, not only in the case of the cast iron wheel but of the steel wheel as well.

While the matter of improving the quality of the wheel must necessarily be a very gradual one and worked out by experiment covering, no doubt, a considerable period of time, the question arises in the meantime what other things suggest themselves as partial remedies. I have already pointed out that the concentration of heat is one of the probable causes of failure at the present time and it has occurred to me that probably something might be done to avoid this. Would it not be possible to so design our brake shoes as to prevent any material bearing or development of friction and heat either at the flange or on the tread of the wheel near the flange where the load is often concentrated? In discussing this matter with one railroad man a short time since, he suggested that he thought the area of brake shoe contact with the wheel was already rather limited, and that if contracted any further it would be a disadvantage rather than an advantage. Since that time I have taken occasion to inspect a large number of brake shoes in service and find that probably not more than one half of those in service have effective use of more than 50 per cent. of their full area. I found also, some years ago, when conducting brake shoe experiments for the Master Car Builders' Association, that when the surface of the shoe in contact with the wheel became hot the metal expanded, changing the shape of the brake shoe so that the bearing was considerably greater at the central part of the shoe and very little at the ends, and that upon cooling, the shape of the shoe was again changed as a result of the wear of the central portion and when thoroughly cooled the brake shoe would take its bearing at the end portions only; so it would appear that little or nothing would be lost by removing almost entirely that part of the shoe which now bears on the tread of the wheel at the throat. This might necessitate some modification of the brake shoe holder and of the point of bearing of the brake-beam, but I am led to the belief that a great deal can be done by changing the shape of the brake shoe alone, that is, by cutting away the bearing near the flange. I wish to point out again that I do not present this as an absolute cure for the difficulties that exist, but as something that would tend in the direction of mitigating the difficulties. In fact, I believe that the means suggested for diffusing the load and preventing the concentration of heat would have a decided influence towards reducing wheel failures.

From one railroad where the service is exceedingly heavy I have obtained the following facts concerning the removal of wheels during the year 1907: Total wheels removed for all causes, 79,000; wheels removed on account of seams at or near throat on tread, without failure of flange, 3,312.

I might say here that this condition is typical of the conditions on a number of other roads with which I am familiar and which I have investigated, and it seems to lend considerable weight to the argument that I have here advanced concerning the concentration of heat and load.

I have already made the statement that of all wheels removed from the service on two typical western roads and four heavy service eastern roads, about 50 per cent. are removed on account of worn flanges, with a maximum of 86 per cent. on one road. The enormous loss of wheel service on this account, to say nothing of the necessity of holding cars out of service for the purpose of renewing wheels and of increased train resistance, seem to be a waste and expense that should be avoided somewhat, at least, if possible. Whether the quality of the cast iron wheel is improved

or whether the steel wheel is brought into more general use, this item of worn flanges will continue and be more expensive with the increased first cost of wheels. Considerable has already been said by others concerning this matter and also about means for preventing it. A few railroads have taken some active steps towards minimizing this waste, but the majority seem to have done little. The difficulty seems to lie in the fact that wheels under cars do not track as intended; that is to say, the alinement of the wheels is not coincident with the alinement of the rails.

It is well understood that this flange wear is not produced as a result of passing around curves; it takes place on straight or tangent track; it is so general and has extended over so long a time that it seems fair to state that the wheels are not permitted to track. I say this for the reason that in some cases where they are permitted to track they do track. It is often the case, as stated previously, that wheels mounted on the same axle are not of exactly the same diameter, and it is the tendency for a wheel of smaller diameter to wear toward the flange. The coning is intended to overcome this difficulty. In some cases it seems to be effective, and in other cases to the extent already noted it does not seem to be effective. There is considerable evidence to show that coning might be made more effective if the resistance of the trucks to pivoting or turning about their pivotal center could be materially reduced.

It has been well established that the resistance of trains has considerably diminished in the case of cars where the body and truck side bearings are free or clear of each other, and where the resistance to pivoting is principally at the center bearing. Numerous papers have been presented and numerous discussions have taken place before this club covering this point, and I think it is safe to say that this principle is so well established that it is regarded as right and necessary to construct cars that shall have the side bearings free and continue so for some time at least. I would call attention, however, to the fact that on some roads, if not on most, where this effort has been made with considerable success to keep side bearings clear, that the percentage of wheels removed on account of worn flanges has, instead of decreasing, actually increased; in fact, on one heavy service railroad, in comparing the service of wheels under 40,000 and 60,000-lb. capacity cars with those under 100,000-lb. capacity cars, I find that the average life of the wheels has been reduced until now it is but 33 per cent. under high capacity cars of that which it was formerly under the lighter capacity cars, and that 75 per cent. of all the wheels removed are on account of worn flanges, which, as I have said, includes those that are worn away from the flange and cannot be remated, but which are not worn through the chill. This would seem to indicate that this condition, while possibly reaching the extreme on this particular railroad, exists to a marked extent on all railroads, or nearly so, and that enough has not yet been done to provide an efficient or partially efficient remedy.

Some years ago one railroad in this country having its interest aroused, determined to pursue this matter with a view of ascertaining what might be done. L. H. Turner, S.M.P. of the Pittsburgh & Lake Erie, has kindly furnished me with a resume of his experiments in this direction. After making preliminary tests about seven years ago and reaching the conclusion that an anti-friction center bearing would relieve the worn flanges, they commenced to equip some of their cars with the ball bearing center and side bearings, so that at the present time they have a total of 8,600 cars so equipped and 6,961 cars without. The latter are older cars of ordinary design, largely coal cars or gondolas. The average life of the ball bearing cars at the present time is between three and four years, quite long enough, it would appear, to ascertain whether the tendency of the ball bearings has operated in the direction of avoiding worn flanges. Covering a period of 36 months, ended May 31, 1907, I find that 19,608, or 86 per cent. of all the wheels removed, both from their own and foreign cars, were removed on account of worn flanges; that 472, or 2.1 per cent., were removed from cars equipped with ball bearings; that 8,926, or 39.2 per cent., were removed from the non-ball-bearing cars of their own equipment, and 10,207, or 44.8 per cent., were removed from foreign cars, out of a total of 22,806 wheels removed from all causes.

It is true that these figures may not accurately and comprehensively state the entire situation, but it would seem to be reasonably clear that with 8,600 cars in service an average of over three years that only 2.1 per cent. of the wheels removed in that time were due to worn flanges, is considerable and important evidence to the effect that if wheels have a better opportunity to track they will do so.

It may be true that the particular device which the P. & L. E. used has not been all that might be desired. It is true that balls have broken and that they have become imbedded in the plates, and there is considerable that may be desired before pronouncing this anti-friction center bearing entirely satisfactory, but there is no gainsaying the fact that if the accomplishment in saving wheels were one-half that which he states, the results should be well worthy of serious consideration.

Some shop tests made recently by one railroad with a view to determining the difference in resistance between anti-friction center bearings and plain center bearings show that the resistance to turning of a dry cast steel or malleable iron center bearing, as compared with the anti-friction center bearing, is as 6 to 1 and in one case over 50 to 1. Mr. Turner, in his shop tests, gives the relation as about 3½ to 1, but there is reason to believe that in service this relation might be somewhat changed and not be quite so great. In case of the bearing used by the P. & L. E.§ the construction is such that in passing around a curve the action of the balls on their seats raises the body of the car slightly and when passing off the curve on to a tangent this elevation of the car body is applied to return the truck to its normal and proper position, with relation to the rail. Other anti-friction center bearings thus far developed do not appear to have included this feature, and it is not evident at this time to what extent this is an advantage, for with an efficient anti-friction center bearing without this feature the wheels themselves would be expected to return the truck to the same normal position.

I feel that the Pittsburgh & Lake Erie is entitled to a great deal of credit in carrying this work as far as it has, and am convinced that in these results which Mr. Turner has presented there must be enough reliable substance to warrant the belief that many railroad men have had, that something of the kind would be valuable for the purpose intended. What I desire to point out in this connection is that one railroad has tried and obtained results, and that if attention and effort are concentrated on this subject by other railroads, or by railroads in general, an entirely efficient means will be developed for relieving the car wheel from what appears to be an unnecessary burden. It is usually the case that where there is concentration of effort, results are forthcoming.

The inability of wheels to track, it would seem, has some bearing on the failure of flanges, in that a wheel would be crowded constantly toward the flange and would necessarily have its load concentrated near the flange. In this way I am of the opinion that some additional relief might be given the already over-burdened wheel.

Finally, to summarize the points that I have endeavored to make, and laying aside, for the present, the matter of improving the quality of the wheel, which is a work that must necessarily go on, I would suggest (1) avoid the concentration of load by the use of a more satisfactory relation between the contour of the wheel and that of the rail; (2) avoid the concentration of heat at or near the flange of the wheel by a modification of the brake practice; (3) relieve the oftentimes existing high pressures against the flange by introducing the feature of lateral motion in truck construction, so that a considerable yielding resistance will be offered instead of an abrupt one; (4) for the purpose of avoiding the excessive wear of wheel flanges of all kinds, modify the contour and provide means whereby the resistance to the pivoting of the truck and of the wheels to track may be very materially reduced.

Foreign Railroad Notes.

The Italian State Railroads have been authorized to contract, in Italy and elsewhere, for 330 locomotives, 270 passenger cars, 250 baggage cars and 10,951 freight cars, at an aggregate cost of about $28,000,000.

A world's electrical exhibition is to be held in Marseilles, beginning April 19 next and closing Oct. 31. The French Prime Minister, Clémenceau, is honorary president, and the Minister of Public Works and other high public functionaries are among its officials.

The Executive Council, to which is committed the oversight of the Italian State Railroads, has had its pay fixed at $2,000 a year for each member, and $6 additional for every day it meets. This council is supposed to represent the people whom the railroads serve.

Putting obstructions on a railroad in order to cause a derailment seems to be regarded as a serious matter in Prussia. Two young men, thinking to amuse themselves in this way, first put heavy iron hooks over the rails and hid nearby to see the fun. The engine shoved these hooks several hundred feet before it was stopped, but did not leave the track. Then they put a number of rails across the track in front of another train; and again the engine was stopped after shoving them some distance. The men were caught, brought to a confession, tried and sentenced to six years in prison—and we may be pretty sure that they will not be pardoned within a year or two.

§*Railroad Gazette*, Jan. 30, 1903, p. 82.

The Railroads of Canada.

BY J. L. PAYNE,
Comptroller of Railway Statistics, Dominion of Canada.

Canadians, with a genuine appreciation of the relationship between transportation facilities and commercial expansion, find satisfaction in watching the growth of their railroad system. In public regard this question is of first importance, as the course of events has demonstrated. To the lavish appropriation of public money, and still more generous gifts of land, in aid of railroad enterprises, no objection has been offered. Federal and Provincial governments alike have opened their treasuries to the owners of charters, while municipalities all over the Dominion have cheerfully assumed heavy debenture liabilities in order to provide the wherewithal for railroad construction. No other people under the sun have done as much to help themselves in this respect as have the sturdy citizens of this northland; and in thus proceeding they have been nudged as much by the stern call of necessity as by the instincts of optimism.

The extent to which our railroads have grown may be gathered from the following statement of mileage in five-year periods:

1863	2,189	1888	12,585
1868	2,270	1893	15,005
1873	3,832	1898	16,870
1878	6,226	1903	18,988
1883	9,577	1907	22,452

For the year ended June 30, 1907, the addition of 1,099 miles must be regarded as satisfactory, in view of prevailing conditions. Scarcity and cost of labor, coupled with swelling prices for supplies, have retarded construction very seriously. For example, the new Grand Trunk Pacific three years ago estimated the cost of their prairie section at $17,500 per mile; it actually cost them during the past year from $22,000 to $23,400 per mile. They were required to pay 50 per cent. more for labor and 100 per cent. more for supplies. The same influences are restraining projectors and contractors generally throughout the Dominion. In this land of forests ties are now costing from 75 to 90 cents each in the West, as compared with 20 to 25 cents when the Canadian Pacific was built in the early eighties.

Over and above the 1,099 miles referred to in the preceding paragraph 324 miles of second track were laid down during 1907. This is practically encouraging. It brings the double track mileage up to 1,067 miles, and completes a total of 27,611 miles of all tracks in Canada. Ontario heads the list with 7,638 miles of line, Quebec has 3,074, and the Western Provinces which were without a single road in 1883, have 8,198 miles. In fact, the Dominion, by one vital test, is the best served country in the world in respect of railroads. With a population of 6,500,000, she has one mile of railroad to every 289 persons, as compared with 381 in the United States, 1,821 in Great Britain, 1,590 in France, 686 in New South Wales, and 10,119 in India. The reverse is true, however, by the territorial measurement, for Canada has but one mile of railroad to every 161.80 square miles of her area, as against 13.61 in the United States, 5.29 in Great Britain, 8.46 in France, 146.09 in New South Wales, and 61.09 in India. These figures will, of course, be materially altered when the 3,500 miles of line now building in Canada are completed.

The 22,452 miles of railroad in Canada represent a capitalization of $1,171,937,808, divided into $588,568,591 of stocks and $583,369,217 of funded debt. This sum is the equivalent of $53,417 per mile, as compared with $65,926 in the United States, and $273,437 in Great Britain. The railroads of Australasia and India are owned by the government, and cannot therefore be compared on the capitalization basis; but the fact that those at the Antipodes cost $63,100 per mile, and those in India, although more than half of narrow gage, $56,800 per mile, would seem to make the Canadian showing relatively satisfactory. Net earnings of $42,989,537 last year yielded 3.67 per cent. on the total capitalization, although the actual results as applied to all the principal railroads were much more favorable. Hundreds of millions included in the statement never have earned, nor never will earn, a penny of dividend. It must also be remembered that Canada has 1,815 miles of line, built, owned and operated by government, the capital cost of which, amounting to $100,958,402, is not included in the figures given above.

In dealing with this question of capitalization, the element of aid assumes an important place. As has been said, no other people in the world have been so generous in this regard. In subventions and land grants the contributions have been as follows:

Dominion Government	$128,827,649
Provincial Governments	35,123,131
Municipalities	17,346,633
Dominion lands	31,762,954 acres.
Provincial lands	20,420,109 "

Here is a total of $181,298,412 in money and 52,183,063 acres of land, quite apart from the cost of government-operated railroads. The cash payments alone amounted to $8,074.93 per mile for the total mileage of Canada, and are over and above guarantees of interest on possibly $100,000,000 of bonds. In 1882 the policy of giving a subsidy of $3,200 per mile to railroads was adopted by the Dominion Government, and in 1898, as an encouragement to the construction of high-class lines, this was increased to a maximum of $6,400, on a basis of half the cost over $15,000 per mile up to $21,400. This was not, however, the commencement of the giving of aid. The $3,200 was in 1882 taken to be the cost of steel rails per mile, and was adopted as a general measure of assistance to practically all new roads; but without any definite policy, many millions had been appropriated in preceding years. Time will probably demonstrate, however, that the granting of from 7,000 to 10,000 acres per mile to lines in the West was the more valuable subvention. The experience of the Canadian Pacific leads to this conclusion. This line was in 1881 given $25,000,000 in cash, 25,000,000 acres of land, and the mileage which had been built in the West by government at a cost of $62,785,319. In 1886 the bargain was modified by taking back 6,793,014 acres of land and substituting $10,189,521 additional in cash. This left the company with 18,206,986 acres of land, which amount it has added to very largely by the purchase of charters from other companies. The Canadian Pacific commenced by selling land at $1.50 per acre; but as settlement progressed this price was increased year by year, until last year it reached an average of $7.15. The company still has approximately 16,000,000 acres for sale, and, with settlers coming into the West at the rate of 200,000 a year, it will be seen that these land holdings, in a rising market, must eventually yield an enormous sum—probably sufficient to pay their total funded liability.

It cannot be assumed, however, that the policy of granting liberal subsidies toward railroad construction will continue indefinitely. Much as Canadians feel the need of transportation facilities, and freely as they approve what has been done to meet that need, there is a growing conviction that the time must be near at hand when the government should close the till against further payments. This judgment is accentuated by the fact that the railroad bill is only part of the total. Canals have cost $92,000,000, and a proposition is now before Parliament for the construction of a waterway between the Georgian bay and Montreal involving probably $150,000,000 more. The cost of administering the present canal system of the Dominion is $1,000,000 per annum. The government, too, is engaged in building 1,800 miles of the new transcontinental railroad through a different country, and when that work is completed another $100,000,000 will likely be added to the gross capital outlay; so that, resourceful as the country may be, the fixing of limitations for the future will soon be imperative.

The total earnings of Canadian railroads for the year ended June 30 last amounted to $146,738,214, which, after deducting $103,748,672 for operating expenses, left a net balance of $42,989,537. Gross earnings have grown more rapidly than has mileage, as the following statement shows:

1882	$29,027,789	1897	$52,353,276
1887	38,841,609	1902	83,666,503
1892	51,685,768	1907	146,738,214

Thus, while the betterment between 1882 and 1892 was 78.0 per cent., it was equal to 180.3 per cent. for the latter decade. Perhaps no other test of growth could be so comprehensive. Certainly no other country within the same period has done quite as well. To make up that amount $95,738,079 was received from freight service, and $45,730,652 from passenger service. Other sources contributed $5,269,483. The proportion of operating expenses to earnings was 70.70, a relative increase over 1906 of 1.2 per cent. Canadian railroads have not fared differently from American railroads during recent years in realizing a steady encroachment on their net earning power. Higher wages and ever-increasing prices for supplies have been the chief influences in this movement.

A summary of items growing out of the results of operation for the year is as follows:

Tons of freight carried	63,866,135
Passengers carried	32,137,319
Earnings per ton	$1.472
" " passenger	1.423
" " mile of railroad	6,535.64
" " train mile	1.953
" " passenger per mile	2.083 cents
" " ton per mile	.702 of 1 cent
" " freight train mile	$2.216
" " passenger train mile	1.513
Passengers carried one mile	2,049,549,813
Tons hauled one mile	11,687,711,830
Average journey per passenger, miles	64
Average freight haul, miles	183
Passenger train mileage	30,220,461
Freight train mileage	38,923,890
Total train mileage	75,115,765
Locomotive mileage	100,154,966
Average cost, one mile, all trains	$1.249
Fuel consumed by locomotives, tons	5,608,954

In connection with the rate of .702 cent per ton per mile, a word or two of explanation is called for. This was the first year in which specific information was gathered of this nature under the schedules and classifications of the Interstate Commerce Commission adopted by Canada in 1906, and the returns in some instances were obviously too high. There are about 70 strictly commercial operating lines in Canada, and some of these in the West, with a low mileage, have exceedingly high rates. The average of these western roads was 12.352 cents per ton. Including these, the average of all lines was 3.655 cents; while 59 roads showed a rate of 2.328. The average, however, for the railroads which hauled 75

per cent. of all the freight was .702 cent. The rate for the Dominion Government railroad system was the lowest returned—.584—on a total of 3,695,641 tons hauled. The average of United States railroads for 1906 was .748.

The operating expenses for the year were, as has been said, $103,748,677, divided as follows:

Maintenance of way and structures	$20,887,092
Maintenance of equipment	21,666,373
Conducting transportation	57,325,543
General expenses	3,869,669

Owing to important changes in classification these figures cannot be compared with those of preceding years.

The average operating expenses per train-mile have increased within the decade from .772 to $1.249; but the gross earnings, which had grown from $1.178 to $1.953 within the same period, more than met this advance. In other words, while the operating charges went ahead by 60.5 per cent., the earnings showed a betterment of 65.8 per cent. This result was due almost wholly to higher traction power, heavier units and road improvements. Earnings per mile of line, amounting to $6,536, were considerably below the $10,460 returned for the United States in 1906, while the comparison of operating expenses was as $4,621 is to $6,912. This reveals a difference in favor of American net results as between 51.3 and 41.4 per cent.; but the measure of growth on the Canadian side has been quite as large as on the other.

An agitation has been begun in Canada for the reduction of passenger rates to 2 cents per mile. The question is now before Parliament, although the sentiment behind the movement is not as yet strong. Hitherto the average revenue per passenger per mile has not been available; but, under the new statistical reorganization applied in 1906, the rate is found to be 2.083 cents. This is but a trifle above the rate of 2.002 which obtained in the United States last year. At the present time the standard ticket charge in Canada is 3 cents per mile with a return rate of 5 cents. There are no 2-cent rates on any of the railroads. The fact, however, that the average passenger journey in Canada was 64 miles, as compared with 30 miles in the United States last year, shows a low proportion of suburban traffic. In the Colony of Victoria—which is typical of all British colonies south of the equator—with a population of 1,200,000, the number of passengers carried was 65,000,000, as against 32,000,000 in Canada; but the average journey was slightly over six miles, revealing a very large suburban business. It is this class of travel which also swells the British returns. So that, having regard to the railroad situation in Canada, a 2 cent rate would practically mean a reduction at least of 20 per cent. in the earnings from passenger service, and it is scarcely likely Parliament will be disposed to impose such a heavy tax on the railroads. This agitation, however, demonstrates the hostile feeling which is steadily, although in large measure unreasonably, gaining force against corporate interests.

For several years past complaints with respect to the available car supply of the Dominion have been persistently made. The Railway Commission has been fairly obsessed by the clamor from shippers, Boards of Trade and other bodies. To laymen the matter, of course, has always appeared simple and the remedy easy of application. "The railroads should buy more locomotives and cars," they say. In this situation special inquiries were made under my direction to ascertain what would be the number of cars obtainable if all the car shops in the country were run at their full capacity. The answers were complete. They showed the annual producing capacity of all the plants, whether owned by railroads or private corporations, to be 227 locomotives, 9,994 box cars, 212 stock cars, 2,221 flat cars, 113 vans, 37 refrigerators, 134 first class cars, 14 second class cars, 44 sleepers, 83 combination cars, 756 other cars for freight purposes and 122 other cars for passenger service—a total of 227 locomotives, 14,333 freight and 397 passenger cars. In 1906 there were 99,884 cars of all classes in use on Canadian railroads, of which 96,565 were in the freight service and 3,319 in the passenger service. On June 30, 1907, the account stood: Freight cars 113,418, and passenger cars 3,632—an increase in the former of 16,853, and in the latter of 313. With regard to locomotives, the number had increased from 2,911 to 3,499. In all these classes of equipment it will be observed that the betterment was beyond the actual number turned out of Canadian shops during the year. A bare 41 locomotives and 455 box and flat cars had been imported from the United States, which were probably all that could be had from that source. The explanation probably lies in too low a return in 1906, and a full accounting under the new schedules.

There is, however, another phase to the matter. Just how many cars were put out of commission during the year could not be ascertained. The railroads fought shy of that question. On an equipment of 99,884 cars in 1906 what should have been the normal depreciation? In trying to determine this important point I soon found that there was a wide divergence of opinion. The estimate of the Master Car Builders' Association is alleged to be too low; it probably is. But who can say what is the life of a freight car? Until the principal railroads join in an honest effort to follow the history of a given group of cars on each system, and something like the actuarial work of insurance companies is applied to this problem, the whole question will remain in the field of conjecture. No value can be attached to the displacements which take place year by year, having regard to the changing character of the units.

Be this as it may, it is apparent from the figures given above that our Canadian railroads did all that was possible to meet the demand for more cars. They bought or built every car that could be turned out in Canada, and probably imported as many more as could be had from United States shops already working under pressure. Yet they were short. The total supply for the year was equal to but 5,218 freight cars per 1,000 miles of railroad, as compared with 8,810 on American railroads. By the same test, the number of locomotives on this side of the line was 156, as against 232 on the other. This shortage of equipment arose from a variety of causes. The increase in freight tonnage, the addition to the mileage in operation, plus the rolling stock put out of commission, combined to keep the railroads in despair notwithstanding the fresh supplies brought in during the year. Producing plants are being increased; but with the growth of railroads and traffic it is doubtful if more locomotives and cars will entirely solve the difficulty. To these agencies must be joined more double tracks, more yard room and increased terminal and siding facilities.

The public side, however, cannot be ignored. Shippers have not added to their warehouse accommodation to the extent of trade expansion. Delays are constant from this cause. Last year the average volume carried per freight car was 594 tons, as against 888 in the United States, clearly demonstrating that our railroads have not obtained the maximum of service from their car supply. These hindrances have been aggravated by an element which does not exist in the United States. Just when Canadian railroads were distracted by the appeals for rolling stock the Lord's Day Act came into operation, practically stopping all traffic on Sunday. I shall not guess at its effect in limiting the movements of trains. The Assistant Traffic Officer of the Railway Commission spent months in studying the matter, and he has officially declared that it has reduced the carrying capabilities of the Canadian Pacific by 21 per cent. That estimate no doubt fits to all lines. Then in the West the Manitoba Grain Act has borne very severely on the railroads by its arbitrary provisions with respect to the distribution of cars, and to protect themselves from heavy penalties the C. P. R., in particular, has had to skimp the East. So that, taken altogether, the car supply problem is not likely soon to be solved in Canada.

During 1907 the number of railroad employees in Canada and their rates of remuneration were ascertained. Even the census had systematically disregarded this important matter. The results are most instructive. Altogether 124,012 persons were employed, and the aggregate compensation was $58,719,493. This sum was equal to 58 per cent. of the operating expenses, and a careful estimate of the relationship of employees to population makes it clear that probably one person in six obtains a livelihood, directly or indirectly, out of the transportation interests of the country. In this calculation shipping is, of course, included, together with all collateral industries.

The accident record for the year is both alarming and distressing. Altogether, 587 persons were killed and 1,698 injured, both numbers being the highest in our railroad experience. The division of the total is as follows: Passengers, 70 killed and 352 injured; employees, 249 killed and 1,126 injured; trespassers, 195 killed and 125 injured; non-trespassers, 70 killed and 88 injured; postal clerks, three killed and seven injured. One passenger in every 459,105 carried was killed, and one in every 91,290 injured. Relatively, there have been two worse years by a small percentage; but the tendency has been steadily in the direction of an annually longer casualty list. Trainmen were killed at the rate of one in 137, and injured in the proportion of one in every 26. This is considerably below the United States record for 1906; but measured by train mileage the Canadian showing is the darker. One or two features of the year's returns are surprising. For example, with the universal application of the automatic coupler and the air-brake two or three times as many trainmen were killed while coupling cars, and by falling from trains, as in the days of the link and pin and old hand-brake. The level crossing cost 69 lives, and the broken rail was much in evidence among the causes of accidents. Collisions and derailments involved the sacrifice of 108 persons, and the injuring of 439 others.

The railroad situation in Canada at this juncture is particularly interesting. The Canadian Pacific has spanned the continent, the Canadian Northern has pushed its western terminus to the Rocky Mountains, and the Grand Trunk Pacific is under construction from ocean to ocean. All this outlay and effort has in view the new Canadian commonwealth which is springing up in the far West, and which during the past year has grown in population at the rate of 700 souls per day as the result of a swelling tide of immigration. Nearly 60,000 settlers came over from the United States during the twelve-month. The peopling of the prairies with producers creates almost at once an urgent need for additional transportation facilities. These newcomers must have the manufactures of the East,

and they must at the same time have an outlet for their pastoral products. In view of these conditions, the Grand Trunk Pacific has made strenuous efforts to complete its central section from Lake Superior to Edmonton. In October last part of that line was opened for grain traffic, and before another harvest has been reaped it will probably have 800 miles in full operation through the center of the great wheat belt. This will mean practically three trans-continental roads in close competition in the West, and before another five years have passed that section of the Dominion, which until 1882 had not heard the whistle of even a construction locomotive, will have more than half the railroad mileage of the country. Out of this development has come a marvelous stimulation to industrial life in the older provinces, and to it are attached the larger hopes of the Canadian people.

At least one enterprising American has made extensive plans to reach out for a share of this new Canadian traffic. James J. Hill has already pushed eight lines connected with the Great Northern system across the boundary, representing a total of 388 miles within the Dominion. He has done this wholly without aid from the government, and at considerable cost. These encroachments are naturally resented by Canadian railroad interests, and rumors of a retaliatory invasion of Great Northern territory are being given currency. Meanwhile, the people of the West are not saying nasty things to Mr. Hill. But just what may be his ultimate ambition cannot very well be guessed from the somewhat scattered nature of his existing enterprises on Canadian soil. Whatever it may be, he at least has the example before him of many United States lines doing business in eastern Canada. The New York Central, the Michigan Central, the Wabash, the Maine Central, the Boston & Maine, the Vermont Central and the Pere Marquette have lines and connections in Ontario, Quebec and the Maritime Provinces, with a considerable passenger and freight traffic. It is to the future they are shrewdly looking, and in that prospect the citizens of Canada are just beginning to discern the measure of their great heritage.

The Ocean Carrier.

BY J. RUSSELL SMITH, PH.D.

III.

*The Origin of the Common Carrier on the Sea.**

The year 1815 brought peace in Europe and America, and what was of particular importance, peace upon the Atlantic. Commerce, freed from the risks of war and increased to greater dimensions than ever before, was now in every respect ready for organized transportation by lines of vessels performing the service of common carriers. The speedy American vessels, built for privateers and with occupation gone, were well suited for this new service, to which they were now turned. Promptly after the peace of December, 1815, a line was established between New York and Liverpool. Others quickly followed. Boston and Philadelphia were soon included. These new lines of sailing packets carried passengers, the mails and valuable freight, and from that time to the present we have had a steady development in the extent, efficiency, permanency, and regularity of line service across the North Atlantic Ocean.

The first line, the famous Black Ball Line of 1816, was founded by Isaac Wright & Son, Chas. H. Marshall and others. Their vessels, of 400 to 500 tons burden, were considered very large and fine and sailed regularly on the first of each month from New York to Liverpool. For the first nine years the average time to Liverpool was 23 days, with a record of 15 days and 18 hours, and the return voyage against the North Atlantic winds averaged 40 days. A second Liverpool line, the Red Star, was founded in 1821 by Byrnes, Grimble & Co., with a monthly sailing day on the 24th. The now prosperous Black Ball Line met this rivalry with enough new ships to despatch one on the 16th. Promptly thereafter the interval in the weekly calendar was filled by the Swallow Tail Line (Thaddeus Phelps & Co. and Fish, Grennell & Co.), which had its sailing day on the 8th, and for the first time New York had the advantage of a weekly packet to Liverpool.

In 1821 Thomas P. Cope & Son, of Philadelphia, merchants, who had for 14 years been in the Liverpool shipping trade, established a packet line from their city to Liverpool, which was sustained through all circumstances. For nearly half a century this was a famous line, and for many years it was Philadelphia's only line.

In 1823 the proprietors of the Swallow Tail Line from New York to Liverpool established a line of packets from New York to London, which survived until about 1870. The founding of this first line of London packets resulted in a second line being founded about the same time by John Griswold (later E. E. Morgan's line).

"About" 1822 the first line was sent to Havre by Francis Depau, and ten years later William Whitlock started the third, the second having been established somewhere in the interval by Messrs. Boyd & Hincken.

The line traffic of the packet ships, now well established to Great Britain and the continent, went on increasing and prospering, new lines being established, new and better ships added, until past the middle of the century. This is the much-boasted period of American leadership upon the seas. Nearly all of our commerce was carried under our own flag and much of the commerce of other countries. We outsailed the ships of other nations and got the lion's share of the passenger traffic. The packets were the most elegant, comfortable and commodious ships afloat. A packet for London in 1823 was advertised as having a physician and a piano on board, and one enthusiastic American writer, with a mind full of details and performances of ships, declares that "in their presence the English and French trading vessels were absolutely insignificant. Their agents, builders and captains speedily became rich, for all were owners—the agent owning, say, an eighth of the vessel, the builder another eighth, in order that he might secure the job of repairing her, which cost about $500 a round trip; the captain another eighth, that he might have the strongest of all motives to vigilance and prowess, the blockmaker and the sailmaker each a sixteenth, perhaps; and the other persons the remainder, a packet of 500 tons being worth about $40,000."

These sailing ships were steadily improved and enlarged, but it is stated that the Mississippi, of 750 tons, was the largest American merchant ship when she was launched in 1833. In 1843 there was a marked increase in size, and in 1846 the New World held the size record and was regarded as a wonder with her 1,400 tons. In 1854 the two Morgan liners, "Palestine" and "Amazon," reached the highwater mark of 1,800 tons. In that year one of these ships put her passengers in London two days ahead of the Cunard Line steamer, having landed them at Portsmouth on the 14th day out from New York. This 14-day record for the packet ships was an unusual, though repeated, occurrence.

The New York packet service to Europe greatly stimulated the coasting trade. In addition to having the local market, the coasting vessel had the surety of being able to forward goods to Europe by the packets, proceeding at regular intervals. Goods came from New Orleans, Charleston, Baltimore, Philadelphia and Boston to be forwarded. The development of coasting lines was the next natural step. In 1818, two years after the origin of the packet service, there was a line of 180-ton sloops running from Boston to New York. There is mention of a "regular packet" to Charleston in 1825. In 1832, E. K. Collins established a line of full-rigged packets to Vera Cruz. The prompt success of this line caused him to send a schooner line to Tampico, and in 1832 the first regular line of packets to New Orleans.

No one should let this account of the packet lines create the impression that the era of the merchant carrier with his individual ship was at an end. The packet lines were limited to the North Atlantic and to the trade of a few ports in America with a few ports in Europe. The long-distance trade of all the rest of the world went on as of yore, while line traffic grew and improved in the one little corner of the world's ocean that separated the commercial metropoli of Europe and North America.

It is rather remarkable that this period of the origin of line traffic should have been also the period of the greatest brilliance in the whole history of single ship enterprise. Yet such was truly the case, through the fame that attended the clipper ship era from 1840 to 1855. The clipper was among tramps what the packet was among liners. The trade with India and China, and later with California, was over routes so prodigiously long, that line traffic was practically impossible, but speed was none the less desirable. So the clipper, profiting by all the experience of the packets, was built, long, sharp and narrow, with every possible regard for speed, so that she might distance all rivals in the race for the ports of the Antipodes. This speed was particularly valuable, because the English tea purchasers coveted the first new teas, and there was an annual tea ship race to get the new crop to the British market. The captain of the ship carrying the first cargo was in an exceedingly fortunate position, because he could sell it out at a fancy price, yielding an exorbitant profit. The time of tea harvest in South China saw annually a fleet of vessels there waiting for the chance to hasten away with the first cargo. This fleet of clippers was largely American, because in the preceding thirty years it had been so repeatedly demonstrated that no other ships were so fast. In 1853, the little clipper "Architect," built in Baltimore, won distinction by placing her tea in London in 107 days from Canton, and getting her whole cargo sold before any of the British fleet arrived. The "Architect" took scrap iron to New York, and there loaded flour and cotton goods for China. Her next tea voyage showed the value of a speed record, for she was at once chartered to take tea to London for £8 per ton, while the English vessels were glad to get £3 or £4 per ton.

The first of the clippers to demonstrate the differentially high value of speed was the "Rainbow," 750 tons, of 1843. She was quickly copied by the leading merchants of the day, but they rather

*References: Harper's Magazine, Vol. 68, p. 217; Scharff & Westcott, History of Philadelphia, Vol. 3, p. 2,216; Harper's Magazine, Jan. 1884; Feb. 1892; Quarterly Review, Vol. 62, p. 207; Hunt's Merchants' Magazine, 1840; British Admiralty.

overdid the matter of speed, for many of these vessels were so light that they were easily strained and the repair bill cut into profits. Then came fast clippers of greater strength and size, reaching up to and passing 2,000 tons. One of these larger vessels, the "Comet," made the record voyage from New York to San Francisco in 76 days, and the "Flying Cloud" made the San Francisco-New York voyage in the astonishing time of 84 days, breaking all records.

In 1854 the "Dreadnought" reached Sandy Hook from Liverpool the same day that the Cunarder reached Boston, and the Cunarder had started one day earlier than the clipper.

The "Sea Witch" was another of these famous ships, which netted her owners $50,000 above all expenses by the freights earned on the voyage from New York to London via San Francisco and Canton. In 1852, 157 vessels arrived at San Francisco, and of these 70 were clippers.

These clippers were often owned by the leading merchants of the period, and they brought a world renown to the American sailor and the American flag, which the Americans of that day enjoyed to the fullest and which the historians of the present make the most of.

The change in the names of the ships from 1815 to 1850 is suggestive of the changed spirit of the men of the time. At first, as they crept out from under the right of search, their ships were named "Hope," "Endeavor," "Perseverance," "Traveler," etc. Then came a period when the names of merchants and captains were commemorated, and lastly came the confidence of triumph, and the ship was named "Challenge," "Invincible," "Flying Cloud," "Sovereign of the Seas."

Several causes contribute to this double triumph in both branches of ocean carrying. It is all included by saying that it was a superior class of men commanding and manning a superior class of ships. This period was dominated by the men who went to sea or went to the counting room in the period preceding the peace of 1815. Most of these men came from New England, where the opportunities for employment were not numerous. The Great West was a wilderness unapproachable by any except those who chose the emigrant wagon and the life of the frontier farmer, whose opportunities for marketing produce were exceedingly meager. Other than this the young men could go to town or go to sea, and they did both. Young men of parts, of family and of education went to sea in those days and began before the mast. The quarter century preceding the peace of 1815 was a time when the risks and prizes of the sea trade were a particular temptation to a lad of courageous, hardy and venturous equipment. Combining this with stagnation at home, we have a reason why some of the ablest men in America should be found dispatching ships and striding the deck between 1820 and 1860. The New England whaler was a schoolship of the most efficient sort for the graduation of the sons of New England into the sea life which they helped to elevate to its most distinguished epoch.

Harried by privateers, pirates, hostile navies and British captains exercising the right of search, the American ship had come to beat the world at running away, and hence was the fastest thing on the surface of the salt sea. The good American sailor had a good ship. The merchants of the day had also often come to the counting house after having risen to the command of ships. With such men having such experience, the era of packets and clippers was natural. There are occasional records of whole crews on an American ship in which all but two or three of the men could perform feats of navigation only known to the officers of foreign ships.

In 1880, with possibilities of safety considerably advanced, insurance rates on the same kind of vessel had gone down 50 per cent.—a direct measure of efficiency of navigation.

The captain of a packet or clipper was a man of more financial and social importance than is now to be found on the ships of peace. He was absolute master of the ship and all on board. The engineer on some great steamer lines is not responsible to the captain. The captain of 1840 was commander, part owner, often attended to the cargo and met merchants on an equality. "His income was often $5,000 a year, consisting of 5 per cent. of all of the freight money, 5 per cent. of all the steerage passage money, 25 per cent. of all the cabin passage money, the entire receipt from the carriage of the mails—two pence a letter from the British Government, and two cents a letter from the American Government and a salary of $360 per annum, and, moreover, he had the privilege of taking his wife and sometimes even her sister, board free."

Forty years later the steamship lines had driven these noble old captains and their ships from the sea, but the steamer captain had not secured his emoluments. The captains of the Hamburg and Bremen liners received $1,200 per year and the Cunard commodore got only $2,500.

The lines, firms and shipping enterprises of the period from 1815 to 1850 grew up naturally and gradually as is the case with nearly all great enterprises. The inception of the famous and record-breaking Collins Line is due to the energy of E. K. Collins, whose career is typical of the period. He was born in 1802, the son of a sea captain. He was reared on Cape Cod, and at 15 was a clerk in a New York store. At 20 he was a supercargo, sharing the profits of voyages to the West Indies and testing his nerves in shipwreck and pirate fray. At 23 he became partner with his father in mercantile business in New York. One day a returning Liverpool packet reported a phenomenal rise in the price of cotton. Straightaway the speculators bought all they could find and engaged passage to Charleston on the packet which departed that afternoon. A rival syndicate was formed to try for this Charleston prize. Their representative was the young Collins, now 23, who much to the merriment of the speculators on the packet crossed the bar beside them in a pilot boat. But he had been down that coast before, and his shallow draught boat followed inshore passages and when the New York packet crossed the Charleston bar, young Collins was sailing out, master of all the cotton in Charleston and on adjacent rivers. His fortune was half made and the next year he married an heiress. Four years later he established a line of full rigged packets to Vera Cruz, then a line of schooners to Tampico, and in 1832 he established the first packet service to New Orleans.

He knew enough about ship building to introduce some new designs for the New Orleans packets, and when in 1835 he sent his "Shakespeare" to Liverpool she created so much interest that she had to decline three times as many passengers as she could carry. Mr. Collins took the hint from this profitable and auspicious voyage and founded the Dramatic packet line to Liverpool.

But scarcely had he got his transatlantic line running when in 1838 the British steamers, "Sirius" and "Great Western," successfully and profitably crossed the Atlantic and were followed by others. In 1840 Mr. Collins is reported to have said, "There is no longer chance for enterprise with sails. It is steam that must win the day. I will build steamers that shall make the passage from New York to Europe in 10 days and less." It took him 10 years to keep this promise, but he did it.

These glowing accounts of success and speed of the sailing vessel are not the whole story. The best sailing ships in the world sometimes had their exceedingly great difficulties in the perverse winds of the Atlantic. There is an account of a vessel that made 5,000 miles and crossed the Gulf Stream three times on the 3,050-mile route between Liverpool and New York. The bark "Ellen," 103 days from Leghorn, hoisted her flag at Sandy Hook and was then driven off to sea for another month with her crew subsisting on macaroni and sweet oil. In February, 1837, the British ship "Diamond," 100 days from Liverpool, reached New York with 163 passengers, having lost 17 from plain old starvation. The packet record for tedium from Liverpool to New York was 110 days. Truly the passenger on such voyages needed many resources for entertaining himself.

These extremes of slowness, like the extremes of speed, should be compared with the average performances of the packet ships, New York to Liverpool, Liverpool to New York.

	Days	
	New York to Liverpool.	Liverpool to New York.
10 year average—1829-39	24	36
1-year average—1839	22½	33 17/24
Record voyages for 1839	18	22
Average of the two new steamship lines—1838-39	13	

The era of the prosperous and triumphant clipper ships was short-lived; 1855 may be put down as the last year of their heydey. A few years before a Yankee offer of $20,000 on a race from Canton had had no takers, but in 1855 a British clipper won a notable race from the East. In 1856 the Panama Railroad was completed and thereby a great prop was knocked from clipper ship prosperity. California trade had been one of its main standbys. Linked in with the China trade the clipper ship made fine voyages round the world. By our coasting trade reservation the Atlantic coast trade to California was an American monopoly. But here came the Panama Railroad joining its steam wagons with the steamers that came down from San Francisco on one coast and went up from Colon to New York on the other, cutting into the clippers' boom of prosperity with a mercilessly quick and regular connection between New York and San Francisco. Eighteen hundred and fifty-six was a black year in shipping rates and a blacker year in the almost abandoned ship yards. The next year brought the panic of 1857 and four years later came the Civil War and the clipper had descended to the inconspicuous common place.

The downfall of the packets was less sudden in that it was a gradual decline spread over a period of 30 years from 1840 to 1870.

The first successful crossing of the Atlantic by steamer was really the doom but by no means the cause of immediate death of the packet ships, despite the graphic journal entry of a passenger on one of the "Black Ball" packets as the "Great Western" overhauled and passed her on this maiden trip to New York: "Then (the steamer) dashing ahead * * * the brave old 'liner' (packet) is no more seen. Her owners will scarcely know her when she reaches port at last. She brings no news. She will soon bear no letters—no species. Nobody will watch for her, nor speak of her, alas! her day is gone by. Who can think of her suffering without a sigh?"

But the steamer did not do all this suddenly. Her struggle upward was slow and painful. In five years after the "Clermont," the first of the steamboats run on the Hudson, 1807, the steamer had conquered the western rivers by ascending the Mississippi and opening a continent by putting lines of steamers on its rivers; but it took more than five times five years more to develop the ability to compete with packet liners on the Atlantic. In the interval the lines of steamers on short voyages and coasting voyages had far outstripped all rival sailing lines. The sailing vessel is good for the open sea, away from the impediments of coasts where sailing ships so often come to grief. The sailing vessels that carried the mail were, when winds were adverse, sometimes many days in making a hundred miles between some British and some continental port. In 1815 a 63-ft. steamer passed from the Clyde to the Thames —the first to be upon that river. Other voyages were soon made and the fitness for coasting service was observed.

The action of the British government concerning the mail service during the decades 1820-40 throws interesting light upon the efficiency of the new lines of sailing vessels and the limitations of their service in competition with steamers on short voyages. About 1820 it was found that steam vessels could satisfactorily carry the mail from Great Britain to the continent of Europe. But there were no private owners in a position to do this work, and from 1822 to 1854 the British government provided its own steamers, the mails being carried in vessels owned and operated entirely by the British government upon regular service, carrying some freight in addition to the mails.

When the government began this service private enterprise in shipping lines was at a low ebb, but it soon seized the new tool for the development of common carriers and the coasting trade is thus glowingly described by a writer in the *Quarterly Review* of 1838 (Vol. 62, page 188);

"There are at this hour scarcely two ports in the United Kingdom of any consideration between which steamers do not regularly ply. In 1818 the most sanguine never dreamed of their being available for much more than inland navigation, with here and there a little circumspect sallying out and skirmishing along the curves of the coast something after the style of the ancients. * * * Who would have believed that by this medium would be maintained our regular communication with all the neighboring ports of the continent and through them with Europe at large?—that every week at least, in some cases daily, London boats would be visiting Hamburg, Holland, Belgium, the French coast, Lisbon and Cadiz?"

At this time the steam coasting service that had survived upon the American coast was limited to Long Island Sound, although in 1818-20 a steamer had made several trips from New York to New Orleans via Charleston and Havana. There had also been some other isolated voyages, but all were of small significance.

During this 20 years, 1818-1838, when the steamer line had been proving itself in the English coasting, continental trade and upon the American rivers and lakes, there had been various sporadic and unsuccessful attempts at long ocean service. The famous voyage of the "Savannah" to Liverpool was not a commercial success, nor was the ship steam-driven all the way. In 1825 a steamer with auxiliary sails went from England to India, but she stayed in the Indian service. In 1830 one went to Australia, but instead of being the founder of a line, she was a heavy loss to her owners. In the late twenties a steamer made a few trips from Europe to Guiana, but she soon stopped and no others followed.

The occurrences of 1838, however, showed that after all of these experiments the steamer was at last ripe for the Atlantic trade. In that year the transatlantic steamer proved itself to the satisfaction of business men and even of the conservative British government. Since 1833 Junius Smith, an American merchant in London, had been laboring on the scheme and finally his company, the British & American Steam Navigation Company, succeeded in landing a steamer in New York from Portsmouth, England, on April 23, 1838, the same day that the Great Western Steamship Company landed the steamer "Great Western" from Bristol. The people of New York went into transports of joy. Later in the year the Transatlantic Steamship Company of Liverpool also sent a steamer to New York, but despite this auspicious start for the record-making year these new steamship companies were not yet able to give a line service of the regularity afforded by the weekly packets.

During 1838-39 their service was irregular, some of them being taken off entirely during the winter. In the words of a writer in *Chambers Journal* (15, 390): "From the absence of method in the departure of the several steamers arising principally, perhaps from the rivalry and non-accommodating spirit more or less characteristic of all competing companies, there was a wanting that faultless regularity in the despatch or receipt of intelligence, which, whether in matters of politics or commercial information, is of the first importance."

The British government also recognized this along with the fact that the steamer was capable of regular line service, and in October, 1838, six months after the crossing of the "Sirius" and "Great Western," advertised for bids for a fortnightly steam service from Liverpool to the United States via Halifax. The bid of the Cunard Company, of Halifax and Liverpool, at about $15,000 per voyage was accepted, and on the fourth of July, 1840, the "Brittaina," a wooden paddlewheel steamer of eight knots per hour, sailed under this contract from Liverpool for Boston, via Halifax. This is the date of the founding of line traffic by steamer across the Atlantic following a regularly maintained schedule that survived in winter and summer and calm and storm.

It should be noted that the introduction of steam made no revolution in the form of service by ocean carriers. It simply gave a new and improved tool for the old work. The line traffic was already established and the Cunards, with their steamers, merely substituted the new type of vessel in the North Atlantic service. It was merely a better line, that was all. The packet lines had taken the passengers, mail and fast freight from the occasional sailing vessel. Now the steamer, faster than the packet, took from it the mail and the freight and the passengers possessing the highest ability to pay.

From that day to this there has been nothing new in the sea service except continuous and rapid improvement of the then existing services and the substitution of new types of vessels for the obsolete.

(To be continued.)

The Era of Steel and the Passing of Wood in Car Construction.*

BY ARTHUR M. WAITT.

The standards of 10 or 15 years ago are considered entirely insufficient and unsatisfactory to meet the demands of the public and the increased business of the present time, and the track, bridges, stations, terminal and transfer yards, locomotives and cars of many of our progressive trunk lines have been almost entirely replaced. It is the purpose of this paper to consider, somewhat briefly, the progress and changes which we see to-day in car construction, especially in the United States and Canada.

There are those living who have seen the development in car construction from a car which, aside from the wheels, axles, journal-box and bearings, center plates and couplers, and the necessary rods and bolts for tieing the structure together, was composed almost exclusively of wood, these cars being built to carry a load of only 10 tons. From this very primitive car to the modern one of almost exclusively metal construction, development has been rapid, and yet only by gradual steps. The modern steel car was not created full-fledged and perfect by the mind of a god as was the goddess Minerva by the power of Jupiter; it has been developed by the plodding, persistent study and work of the human minds and human hands of the master car builders, whose ruling motto was, "To do with their might whatsoever their hands found to do." The substitution of metal for wood came gradually, necessitated by the rapid wear and frequent breakage in service of parts too weak for the duty demanded of them.

John Kirby, formerly General Master Car Builder of the Lake Shore & Michigan Southern, who is probably the oldest living representative of American master car builders and who has been largely responsible for the highest development of the American wooden freight car, stated to the writer that his first knowledge of metal car construction in this country was in 1853, when the New York Central had a few hundred box cars made principally of metal, although the body bolsters, inside sheathing, floor and roof boards were of wood. These cars gave fairly good service for a few years, but corrosion took place just above the sill line in the outer metal covering, and considerable patching was required; nevertheless, they continued in use many years. As early as 1860, Mr. Kirby put in passenger car service the cast-iron brake-head and shoe as a substitute for the wooden block and the wooden block with an iron lining; again, in 1868, he designed and put in service the double, metal body bolster as a superior substitute for the old wooden bolster.

So far as the writer can learn, the earliest metal cars used in this country were a large number of four-wheel iron cars built by the Baltimore & Ohio prior to 1853. These were built for carrying coal, and were in constant use for that service up to the time that all four-wheel cars were discarded from service, which was some 20 years ago. In 1861 the Eastern of France began substituting iron sections for wood in car construction. In 1895, 34 years later, this company had over 20,000 cars with metal framing or of all-metal construction. The first 50-ton pressed steel hopper-bottom car built in America was exhibited at the Master Car Builders' convention at Old Point Comfort, Va., in 1897. This was the first year that modern metal cars were built in any large number in this country. They were designed and built especially for the coal and ore trade, and, though of much lighter design than cars for similar purposes constructed to-day, they have been in continuous service

*Abstract of a paper presented at the January meeting of the New York Railroad Club.

for 10 years, and on the average show very little deterioration from service or corrosion. Steel cars in service on the Eastern of France since 1869 are said to have shown a loss of only 6 per cent. in corrosion as a result of the first 28 years of service. Only in a very few cases, and those where exceptional and unusual conditions existed, has there been publicly reported any serious deterioration of modern steel cars from excessive corrosion.

M. L. Tolmar, Chief of Shops on the Eastern of France, has, within a few years, published in the *American Engineer* an interesting series of articles in connection with the company's long experience with the metal car. Mr. Tolmar estimated that the life of cars with all metal underframing would be about 50 years, so far as the body frame is concerned. Where the upper frames are of metal, he found that these give out first, while the underframes are still good. In general, his conclusions were that the steel underframe car would have double the life of the car with a wooden underframe. Some of his further conclusions were:

"In the design of the cars the smaller the number of pieces the better. Rivets are better than bolts. Good rivets give no trouble. Cars of all steel construction should, if possible, have the inside at exposed places cleaned and repainted every three years." The use of all steel upper frames for box cars is not encouraged by Mr. Tolmar. He further says: "We have never been able to prove, even in shops where 30,000 cars a year are repaired, that damage to the frames was attributable to disappearance of rivets or the premature weakening of sections by rust." The final conclusions regarding the use of steel cars in preference to wooden ones are as follows: "First—In an enterprise or an undertaking of a transitory nature one can be content with wooden cars, which for 15 years will not involve expense greater than those of mixed or iron frames. Second—The enterprise of long duration should seek permanence in its construction at the risk of diminishing a little the benefits accruing during the earlier years, and to this end must use metal frames."

Shortly after the appearance of the first steel hopper-bottom coal cars in 1897 some very interesting comparisons were made by C. T. Schoen, designer of these original pressed-steel cars, as to the cost, life and maintenance of such cars as compared with wooden ones. Any one interested in learning the basis for the claims made in favor of the steel car at that early date can see them by referring to the *American Engineer* for February 25, 1898.

The early advocates of steel cars made a great deal of the advantage due to the lighter weight as compared with wooden cars of similar capacity. In the early days of steel car construction the additional cost as compared with wood was quite considerable. To find favor in placing the new cars on the market it was necessary to show some material offset for the added cost. In order to accomplish this by reduction in weight the earlier steel cars were made somewhat too light to stand in an entirely satisfactory manner the strains of service. In later designs this fault was gradually rectified so that the cars turned out at present are almost always fully capable of resisting the shocks in the heavy trains in which they are run, and they are standing up quite satisfactorily. With the exception of the results of collisions or accidents the steel car of to-day is for the first few years of its life nearly free from repairs other than the renewal of wearing parts, such as brake-shoes, wheels, axles and journal-bearings. The deterioration from corrosion and other causes is hardly noticeable in cars from eight to ten years old, except in a few cases where they are used under unusual and exceptional conditions. Foreign roads, as well as some American roads who have reported on the subject, have found that there is almost no cost for repairs to steel underframes in the first four years.

According to the *Railroad Gazette*, in the year 1907 there were 289,645 cars built in the United States and Canada by car building companies, and of this number 280,216 were for domestic use. About 72 per cent. of the freight cars built were of steel or steel underframe construction. This is a growth of over 400 per cent. in the proportion of steel cars as compared with the record of 1901. The capacity of the steel car works in the country has been materially increased during the past four years; at present the total available capacity for building steel cars has been increased to about 150,000 cars a year, and the total available capacity for all kinds of freight cars approximates 1,000 cars per day, which would seem to provide amply for the number of cars required yearly for some years to come.

In the statistics of freight cars ordered during 1907, it is interesting to note that, with the exception of a few built for private companies, for small railroads, or for special purposes, the great majority are of 80,000 lbs. and 100,000 lbs. capacity except for roads in the southern states, in New England and in Canada. For roads in the latter groups, many cars of 60,000 lbs. capacity are still being built.

The "passing of wood in car construction" is not only due to the greater economy in maintenance, the greater stability and efficiency and the much greater safety of the steel car, but is being forced by the scarcity of suitable lumber, as well as its rapid increase in cost. In a paper prepared by R. L. McCormick, President of the Mississippi Valley Lumber Men's Association, on "The Exhaustion of the Lumber Supply," he states: "The present stand of yellow pine in the southern states has been stated by R. A. Long in a paper read before the annual meeting of the Southern Lumber Manufacturers' Association to be about 137,000,000,000 feet. For the census of 1900 the total cut of yellow pine was given as nearly 10,000,000,000 feet. These figures show that at the present rate of consumption the present stand of longleaf yellow pine will be exhausted long before a second crop could be produced." In a pamphlet published by the United States Department of Agriculture on the "Waning Hardwood Supply," the following statements are made: "The hardwood lumber cut in 1899, according to the census, was 8,634,021 thousand feet; in 1906 it had fallen to 7,315,491 thousand feet, a decrease of 15.3 per cent. That the decrease is due to diminished supply rather than to lessened demand seems to be proved beyond question. During the same period the wholesale price of various classes of hardwood lumber advanced from 25 to 65 per cent. The most notable shrinkage has been in the leading hardwoods to which the public has been long accustomed. Oak, which in 1899 furnished one-half the entire output of hardwood lumber, fell off 36.5 per cent." As to the supply of hardwood lumber in sight for wooden car construction, Mr. Hall says further: "The plain truth is that in the Appalachians, as in the other regions, the hardwood lumbermen are working upon the remnants. The supply is getting short and the end is come into sight. The largest estimate sets the figure for hardwoods at 400,000,000,000 feet. If we are using hardwoods at the rate of 25,000,000,000 feet per year this would mean a 16 years' supply. There is no hardwood supply in the far West. When the supply in the central and eastern states is gone there will be no other source to which to turn." The Norway pine supply in the United States is about exhausted. The most available substitute for yellow or Norway pine for car sills is the Oregon fir, of which there is an ample supply for many years to come; but which must necessarily be high in price as well as less suited in strength for the requirements of service for freight car framing.

There are three distinctly different theories and systems in connection with the design for steel cars, each supported by able advocates. With one system the designers endeavor to carry the load on the side sills, using the center sills for buffing only. Another school of design endeavors to distribute the load nearly equally over all the sills. This design necessitates somewhat heavier construction than the former. The third school, which has the support of several car builders, endeavors to carry the load largely on the center sills, which are made very deep (even up to 30 in.); the center sills thereby not only carry the load but are also exceptionally strong to resist buffing. With the rapid introduction of steel car framing and its permanence in future practice, it seems at this time desirable as far as possible to eliminate the present great diversity of designs; such diversity makes it impossible to keep in stock the necessary parts for interchange repairs in the shops and repair yards of the various roads in the country. Not only is it desirable to simplify and eliminate this great diversity of design, but there are also many strong arguments for working toward a body framing in freight cars, which will permit of an underframing interchangeable for box cars, gondolas and flat cars. The system of body framing which carries the load largely on the center sills seems to have a basis which will make it readily possible to have the body framing interchangeable as above suggested.

Much has been done in past years toward unifying and simplifying the design of wooden cars, and it would seem that sufficient experience has now been had with cars of all metal construction, or at least of all metal underframing, to make it desirable for the Master Car Builders' Association to take similar steps soon in regard to them. It seems perfectly feasible at this time to adopt as recommended practice, and later as standard, some rolled and pressed sections, at least in the main members of the body framing. A move in this direction would before long be felt in increased simplicity and economy in interchange repairs. It would seem even possible at this time to adopt standards in lengths and widths for steel box, gondolas and flat cars, and then as a natural sequence many standard shapes and sizes would follow. It would be also practicable to standardize many of the rolled sections for angles and channels which are used in the superstructure of many styles of cars.

In freight and in passenger car construction during the development period in the past the cars were strengthened where found necessary; there were all sorts of makeshift methods and devices, such as truss rods, flitch plates, etc., and malleable iron was introduced in place of cast-iron. All this was done to make the cars stand up in service, with their increasing size and the increased severity of the work imposed upon them. All proved ineffectual and unsatisfactory, and the needs of our present-day service can be met only by a car with steel body framing.

During the past year one prominent road in the country has designed and constructed box cars with not only a steel under-

framing, but a steel superstructure. This is a daring attempt to further develop "the era of steel" for car construction, but the practice is one which would seem open to decided doubt as to whether entirely satisfactory results will be obtained in service. On first impression the observer might assume from the description or examination of the all-steel box car that it was in every way a decided advance step. It is to be hoped that railroads will very carefully consider the history of steel box cars both abroad and at home before going heavily into their construction. In a communication which the writer published in the *Railway Age* in reference to this all-steel box car, it was stated: "From a standpoint of structural design and practical construction no serious difficulty may be feared in this departure for American railroad service, but from the standpoint of service conditions, the development should be approached with great care. In America, freight cars go from north to south and from east to west without territorial restrictions. Any satisfactory car adopted in America for general use must be one suited to the hottest as well as to the coldest temperatures, and they must be adapted to the rapidly varying climatic conditions of an enormous area of diversified country.

"If one has spent hours in midsummer in large railroad yards where great numbers of steel gondolas are stored they need not be further enlightened as to the enormous heat in such yards due to the accumulation stored up in the sides of these steel cars. Many times in midsummer the steel sides and ends of the cars are too bad to be grasped with the bare hand. If such cars were covered with a roof of sheet steel on which the direct rays of the sun would fall, and in addition have steel sides and ends, the heat emanating from them would be enormously increased, and the temperature inside such cars would not only be destructive to any forms of life in them, but would be seriously injurious to a large variety of the different classes of freight ordinarily carried in box cars.

"In summer time in a yard where large quantities of all-steel box cars might be stored, the heat would be sufficient to seriously injure, and possibly kill cattle, hogs or sheep that might be in trains which were held any length of time in such yards. With cars carrying grain, the heat in summer-time would be injurious to such grain and would seriously depreciate its value. In winter, with sudden changes of weather from hot to cold, the deposits of moisture from the atmosphere which are so frequently noticed on the sides of locomotive tanks would occur with many classes of lading, on either the inside or outside of such cars.

"It is argued that steel grain elevators have been successful, and that they do not require lining in order to prevent the grain from sweating or becoming dampened as the result of sudden changes of temperature. The writer has been advised, however, that considerable trouble has been experienced with steel storage elevators for grain, and in order for them to be at all satisfactory for general use in climates subject to considerable variations in heat and cold and variations in humidity, it is necessary to have them lined, giving an air space between the inner and outer casings.

"In the design of all-steel box cars which have recently been illustrated in several of the technical papers, there seems to be no provision made for an inside lining either at the ends or the sides. For carrying grain, as well as many other classes of freight, such a lining made of wood would seem absolutely necessary as a protection from heat as well as cold, as a non-conducting air space between the outside sheeting of the car and the inside lining is always necessary to prevent damage to many classes of lading. The addition of such a lining, which in an all-steel car would be necessary for the roof as well as the sides and ends, will so add to the weight of the car as to give the all-steel car no advantage over its wooden superstructure predecessor so far as weight is concerned.

"When one realizes that in box cars heavy machinery and automobiles are often loaded, and when it is remembered that in properly blocking the lading as well as properly stowing it in the car, it is often necessary in some manner to get a good hold on the floor in order to readily move the machinery or other articles to a convenient place, and furthermore, when it is remembered that many classes of freight, such as automobiles, carriages and machinery, it is necessary to fasten blocks on the floor to prevent the lading from shifting, it will be seen that no small amount of difficulty will be experienced with a box car floor composed of steel sheets. It should be remembered that in a large number of cases the load is put in the cars at points where the men doing the loading do not have conveniences for making and adjusting long braces to properly hold the lading in position. In case of renewal, convenience of moving and securing the lading, a floor composed of 1¾-in. or 2-in. plank has many advantages over thin steel plates.

"It would seem wise in the development of the steel box car construction that progress should be made slowly and with great care, and to this end it would appear first desirable to design a car with a steel underframing and a steel framing for the superstructure, which is entirely practical, but to protect the car both on the sides, ends, roof and floor by a covering of wood, which, with present experience as a guide, is much more suitable and better adapted to the peculiar and varied climatic service conditions met with in freight traffic on the lines of our American railroads." In the construction of gondolas and flat cars, except where such cars are likely to be used in service for hot cinders, hot billets, or some similar lading, it would seem to the writer the wisest policy to use a wooden flooring rather than steel.

In a paper read before the New England Railroad Club in 1904 by John F. MacEnulty, he said: "It has been determined by two of the largest railroad systems of the country that the drawbar pull required to move a ton of freight in a properly constructed car of 100,000 lbs. capacity is 24 per cent. less than that required to move the same load in an average wooden car of 60,000 lbs. capacity." This is not only a strong argument in favor of steel car construction, but also for the use of large capacity cars.

Ease of renewal of the worn or broken parts in steel car construction is a feature of considerable advantage in favor of such cars as compared with those made of wood. Another great advantage is found when trains are wrecked, for steel cars withstand successfully punishment which would mean the total destruction of wooden cars. It has been found that the parts bent or torn in damaged steel cars can be readily renewed or put back in their original shape at a comparatively reasonable cost. The cost of steel cars per ton of carrying capacity is in general less than that of wooden cars. In large wooden cars it is found that the ratio of light weight to carrying capacity is altogether too high for comparison with steel cars. In cost of maintenance the steel car has a decided advantage.

The life of wooden cars built to-day must necessarily be shorter than those built 15 years ago, for at present it is impossible to get lumber anywhere approaching in quality that which was required in first class freight cars in 1892.

The demand for cars has, during the past few years, been so much in excess of the supply that cars have not been taken out of service for needed repairs so long as they could be kept going and pass inspection for safety. Under such conditions the wooden car has suffered very materially and depreciated rapidly. The increased cost of all kinds of material going to make up the car has so added to the cost price that one of the principal arguments against steel cars has been nullified. Length of train and increased size and weight of the average car, together with the very great increase in size of locomotives, during the past decade, has subjected cars to such increased strains as to make the strength of the wooden car of 10 years ago insufficient for economical service in heavy trains on our trunk lines. The continued construction of the so-called wooden cars for general use and interchange on trunk lines is an uneconomical proposition, and cannot longer be justified except on the narrow policy of a temporary saving of slight amount in first cost, regardless of the following increased cost of maintenance, and increased amount of depreciation, which the officers ordering such cars do not expect to have to justify during their own terms of office.

As showing the conclusions arrived at on one of the prominent railroad systems of the country, the writer has had before him a report recently made to the chief executive officer of the company. The report recommends retiring 4,600 coal and coke cars ranging from nine to 23 years in age, and having from 40,000 to 60,000 lbs. capacity. It was shown that these cars, on the average, cost $95.98 a year for repairs, or 37.8 per cent. of the average value of the cars. It was shown conclusively that the company could buy 3,000 new steel cars having a total capacity 20 per cent. greater than that of the 4,600 wooden cars, and out of the amount that it would cost to maintain the wooden cars for one year they could pay 6 per cent. interest on the cost price of the new steel cars and have remaining over $215,000.

There are, unfortunately, some executive officers whose policy is to make a great financial record for themselves for a few years, regardless of the consequent depreciation of the property entrusted to them, and regardless of the fact that their successors will have to spend much money later to correct the evils resulting from a selfish, shortsighted and necessarily short-lived policy of those who preceded them. On railroads dominated by such a "penny wise and pound foolish" policy (or lack of policy), it may be expected that the "era of steel" for underframing for all freight cars will be deferred as long as possible, even in the face of undoubted evidence that the wooden-framed car is an uneconomical structure.

It is only during the past three years that much has been done in this country to adapt steel construction to the various styles of passenger equipment. During several recent yearly visits to Europe, the writer found that the use of steel underframing for passenger equipment is now quite general both on the Continent and in Great Britain; but the use of practically all-metal construction has been quite limited in the past, abroad as well as in America.

The many serious railroad accidents of the past few years, and the use of electricity as a motive power, both as a substitute for steam in heavy railroad service as well as its use for lighter service in subways and elevated railroad traffic, has given the design of all-metal cars for passenger transportation a rapid impetus. Very satisfactory designs have been developed for baggage and postal

cars, as well as for suburban and regular passenger service, and within the past year, also for Pullman sleepers. It is too early yet to predict the outcome, but it seems to the writer that in future development of designs for steel passenger equipment a happy medium may be found and generally adopted, where the underframes and the superstructure framing will be of metal, but a reasonable use be made of wood or some fireproof substitute, other than metal, which will permit of a decorative treatment more pleasing to the eye than thin metal, and which will also have all of the reasonable and necessary elements of safety for those who entrust their lives in such cars.

In the early days of steel cars the matter of repairs was looked upon with many misgivings by the average master car builder and car repair foreman. Experience in handling these cars in large numbers has shown that there was no cause for any uneasiness on this score. In the repairs of steel cars it is not necessary to employ specially trained labor, and very few extra tools or facilities are absolutely necessary, though, of course, a few especially adapted tools and appliances will greatly facilitate the work. On roads having large numbers of steel cars in service it has been found that not more than one-half of 1 per cent. of this equipment need be out of service at any one time, needing repairs, while in the case of wooden cars from 2 to 4 per cent. is not unusual.

Relations Between Interurban Railways and Steam Railroads.*

You have a territory that is probably 20 to 30 miles wide, between the main lines of your steam railroads. Apparently all of the business that can be secured in that territory is being well and efficiently handled by the steam railroads. Until five years ago there were no evidences that such conditions were not satisfactory or ideal to the people in between those main lines, simply because these people had no idea of any better or more efficient transportation service. As the country further east became more thickly settled, the merchant, manufacturer and farmer found that a greater degree of prosperity attended the locality where it was easy to get about quickly. The result was that between main lines of steam railroads in territory that was reasonably densely populated, there was usually not sufficient additional business in sight to cause the steam lines to spur out 15, 20 or 30 miles and put on the mechanical appliances necessary to efficiently operate that spur. But the people in between demanded additional service. Your electric railway man in cities then began to reach out his line 15, 20 and 30 miles. As he reached out, it was found not only that he did not impair the freight and passenger business of the steam railroad, but he generated business in between those main lines and brought it into the stopping places of the steam railroads, adding to their receipts. For instance, take as an illustration two railroads 20 to 25 miles apart. A man would have cattle enough on the place for the milk supply of the family and possibly a few gallons over. He would raise vegetables enough in the garden to supply the family, and have a few bushels over. There would be a certain amount of farm produce, for instance hay, that was not consumed. All that was wasted; the steam roads did not come in and take over that sort of business. The electric railway man came into the field, and people found it profitable not only to keep cows enough to supply themselves, but to send off a half dozen cans or a dozen cans of milk to market. They also found, at times when they could not work the large crops in the big fields, that it was possible to attend to smaller products, cabbages, celery, etc., and to take care of the orchard, to plant plum, peach and pear trees, and they found a ready sale for all that sort of stuff whenever they got to a point where they could reach the market. The electric lines developed that business, and where you find electric railways and steam railroads in contact with each other, you will find territories that produce 50 to 60 per cent. more in any line of small produce than they do where there are no electric railways. The electric railway takes up the commodity and delivers it to the next nearest stop for the long distance haul of the steam railroad, and any railroad that has such shortline feeders pays more per mile than the line that does not have them. I do not believe that steam railroad managers have given this subject attention enough to appreciate the ratio of increased business.

The profit from the operation of any railroad depends directly upon the population and productiveness of the territory it reaches. Take the case of the more newly settled parts of the country. We have, between the Mississippi basin and the foot hills of the Rocky mountains, five or six trans-continental lines that are absolutely losing propositions in the local territory, for the reason that the population is sparse and the productiveness of the country, outside of livestock, is absolutely nil. If there can be any conditions brought about whereby the population of these localities is increased, and whereby the productiveness of these localities is increased, it will add revenue to the long-haul transportation company's treasury. Wherever electric railways have been installed connecting two cities with a country strip of territory intervening they have resulted in an increased population ranging from 10 to 15 per cent. for the first three years after the installation of the electric railway.

Following the electric railway, there is an increase in population and in production, and that increased production gives additional freight traffic and passenger traffic to the road that goes to New York or San Francisco. I have figures here, taken from the records of the railroad commissioners at the State House, showing the increase in population in interurban localities in Iowa. The railroad officials in Iowa recently called attention to the increased population that had been brought about by interurban railroads while the population of the state, as a whole, decreased 30,000 between 1900 and 1905. Between Waterloo and Waverly, which are connected by electric railway, the population in the townships, exclusive of towns, increased from 3,845 to 4,805. The population in the townships between Iowa City and Cedar Rapids, outside of the towns, increased during the same period from 11,512 to 13,456. The townships between Des Moines and Colfax, exclusive of the towns, increased from 8,633 to 9,178.

At the commencement of interurban development around Indianapolis, the population there ranged from 168,000 to 170,000. At the present time, I am informed by the president of the American Engineering Company of Indianapolis that the population exceeds 250,000. Every steam railroad that runs into or out of Indianapolis gets its proportionate share of the passenger traffic of that 250,000 people and its proportionate share is greater than it would have been had there been no interurbans to add to the population of Indianapolis. In addition to that, there is the proportionate share of the freight over their road that is manufactured by the increase in population. The same thing is true of every center in the United States which has fostered the building of systems which reach out over the adjacent localities; the centers have an increased population and that increased population increases every line of business in the territory.

For the last two years I have been driving across this country that we expect to occupy. The people pay no attention except to the farm business. They possibly go either to Creston or Des Moines and they don't think about going back to make the folks down east a visit; they don't think of going to the Exposition; they don't think of going to California or Florida for the winter. Why? Simply because they haven't the vision of a car just passing their door every day. They have got to climb into a lumber wagon or surrey, which is an inconvenient way of riding, and drive six or eight or ten miles to get to the nearest steam railroad station. The result is, they do not think about going back to see the home folks. The same class of people, in those states with the advantages that we have in Iowa, see an interurban car go by their door every day, and the first thing they do is to get on an interurban and go down six or eight miles to see John Smith about a bunch of cattle, and then the good wife gets on a car and goes six miles the other way to see Sarah, and the first thing you know, they get the riding habit and they go to the interurban man and want to know how to get to some point in Indiana or Ohio. The interurban man can only carry them 25 miles, but he is foxy enough to know there is a little bit of commission in selling the ticket, and he goes to the steam line ticket man and gets the price, and the result is that the steam line gets four or five passengers that it would not have got in 20 years unless the electric railway people had started them. The percentage of long distance travel at Jackson, Mich., to New York City, New Orleans and San Francisco has increased some 18 per cent. in six years. That is the effect of the interurban, building the electric railway has opened up new steam railroad business.

So long as any of us are alive, I believe that trains of eight, 10 and 15 cars will always be hauled through the medium of steam, and I sincerely believe that the day will come when the ability of man to build a machine big enough to haul the people who are teased into the desire to travel by the electric railway, will be taxed to the utmost.

*From an address by A. E. Park before the Iowa Railway Club.

The Swiss Diet has declared that the Simplon parallel tunnel shall be enlarged, lined and made ready for a second track immediately. Brand, Brandau & Co., the contractors who built the tunnel now in operation, contracted also to complete the parallel tunnel for a given sum if notified to do so by Feb. 8, 1908. The firm does not wish to undertake it. It made only $240,000 on the work heretofore done, or 2 per cent. on the expenditure. One of them died before the tunnel was completed, a second became an invalid, and a third is 70 years old. Moreover, the traffic so far is abundantly accommodated by a single track. But the State Railroad authorities say that the parallel tunnel must be enlarged and lined to preserve it and to prevent the deformation of the other tunnel where the track is. Moreover, if the work is not begun till the second track is needed, it will be much more difficult to do it. While there are few traffic trains on the existing track it can be utilized for the new construction.

GENERAL NEWS SECTION

NOTES.

The conference of railroad commissioners called by the Commission of Oklahoma will meet on January 28 at Oklahoma City. The states to be represented are Missouri, Kansas, Arkansas, Texas and Oklahoma.

The State Railroad Commission of Wisconsin has ordered six of the principal railroads of the state to reduce by 33⅓ per cent. their rates for carrying pulp wood. The paper makers have been asking for this reduction for over a year.

In the Federal court at Kansas City, January 20, Judge McPherson decided unconstitutional the law of Missouri forbidding railroads to remove to the Federal courts suits begun against them in the State courts to compel compliance with the rate laws of the state.

The State Railroad Commissioners of Montana have issued demurrage regulations to be adopted for freight cars throughout the state on February 8. On coal, lumber and precipitates three days' free time must be allowed. The demurrage charge after five days is increased gradually to a maximum of $2 car per day.

The Supreme Court of New Jersey has decided in favor of the railroad a suit brought four years ago by J. G. Montgomery asking to have condemned as extortionate a charge of 10 cents made by the railroad for the storage of a package in the station at Pemberton, which Montgomery had brought with him from Philadelphia, but which he did not take away for several days.

The Subway lines of Manhattan, New York City, operated by the Interborough Rapid Transit Company, having been extended from the southern terminus beneath the East river to Brooklyn, are carrying more passengers than ever before. On Monday last the total was 704,879. On the same day the Elevated lines, operated by the Interborough, carried 910,215, making a total of 1,625,094 passengers on the Interborough system.

The time of the Twentieth Century Limited Express trains over New York Central lines between New York and Chicago has been shortened. The westbound train is now scheduled to run through in 18 hours 30 minutes, one hour less time than by the schedule abandoned, but still 30 minutes slower than the summer schedule; and the eastbound train runs through in 19 hours, which is a shortening of 30 minutes, but still is one hour longer than the summer schedule.

The Philadelphia & Reading has announced in Philadelphia that at the end of this week 60 local passenger trains will be withdrawn, passenger receipts having fallen off seriously. Nineteen trains will be taken off the Chestnut Hill branch, six from the Norristown division, six from the Frankford division, seven from the Glenside division, three from the New York division and smaller numbers from other divisions. The announcement says that it is believed that the trains will not be seriously missed by the public.

The disagreement between the New York, New Haven & Hartford and its connections appears to be the subject of varied and successive complaints before the Interstate Commerce Commission. The Central of New Jersey and its connections have now filed formal proceedings alleging discrimination on the ground that the New Haven continues with the Pennsylvania and the Lehigh Valley arrangements which it threatens to break with the complainants. There are rumors that a compromise will be reached, but no substantial grounds are given for the rumors.

The Governor of Tennessee has invited the presidents of the principal railroads of the state to meet him January 27 to see what can be done about reducing passenger rates and obviating the necessity of calling a special session of the Legislature for that purpose. In the meantime, the State Railroad Commission, apparently looking upon the action of the Governor as too slow, has issued an order requiring the railroads of the state to reduce their fares to 2½ cents a mile on the first of April. The railroads declare that they will ask the courts to forbid the enforcement of this order.

The Southern Railway has decided to extend voluntarily to all its passenger traffic in Tennessee the same rates which it expects shortly to establish in many of the Southern states as a result of the compromise agreements now being reached between the road and those states in which rate laws were passed last year. No rate laws have been passed in Tennessee. President Finley says that compromises are being reached in most of the states on the basis of 2½ cents a mile for single tickets, 2¼ cents a mile for family mileage books, and 2 cents a mile for commercial mileage books. These rates are to be put on trial for a period of 12 months. In North Carolina a special session of the Legislature has been called to pass an act validating the understanding regarding rates which has been reached between the Governor, the Railroad Commission and the Southern Railway. In South Carolina it is expected legislation along the lines of the compromise will be enacted. In Georgia the Railroad Commission is supreme, and an understanding has been reached with the commission. In Alabama the situation is about the same, and in Mississippi it is expected the necessary legislation will be passed.

Government Statement of Monthly Railroad Earnings.

The Interstate Commerce Commission last week made public for the first time as provided by the law passed by the last Congress, figures showing the monthly earnings of the separate railroads. A typical example is given below in order to show the method of reporting railroad income results according to the revised accounting standards now in force. The showing of the Pennsylvania Railroad for November, 1907, is as follows:

Pennsylvania Railroad.

Freight revenue	$9,958,743
Passenger revenue	2,606,390
All other revenue from transportation	1,137,551
Revenue from other operation	122,849
Total operating revenue	$13,825,534
Maintenance-of-way and structures	$1,402,679
Maintenance of equipment	2,688,946
Traffic expenses	172,072
Transportation expenses	5,244,408
General expenses	289,454
Total operating expenses	$9,840,974
Net operating revenue	3,984,560
One-twelfth of annual taxes	174,339
Operating income	3,810,220

Opening of the Guatemala Railway.

The Guatemala Railway, which is controlled by the United Fruit Company, has finished its through line from Puerto Barrios, on the Atlantic coast, to Guatemala City, the capital of the republic, about 200 miles, where it will connect with the Guatemala Central, which runs to San Jose, on the Pacific coast, 70 miles. The United Fruit Company has announced a new fortnightly steamship service between New York and Puerto Barrios. The new line is to be put in operation on February 1.

Exports of Grain, Beef and Cotton in 1907.

During the calendar year 1907 the recorded exports of wheat from the United States were 89,897,600 bushels, valued at $84,859,379, an increase of 47 per cent., as compared with 1906, when 61,347,789 bushels, valued at $47,716,891, were exported. There were 15,191,351 barrels of wheat flour exported as compared with 14,259,252 barrels in 1906. Exports of canned beef fell from 35,028,912 lbs. to 21,948,354 lbs., while other cured beef decreased from 73,638,734 lbs. to 50,354,835 lbs. Exports of fresh beef decreased very slightly. The year's exports of cotton, other than Sea Island, were 4,404,992,246 lbs., valued at 10.7 cents a pound, which compares with 3,471,934,550 lbs. at 11 cents in 1906.

Effect of Eight-Hour Telegraphers' Law in Wisconsin.

The last Wisconsin legislature passed an eight-hour telegraphers' law and a number of complaints have now been filed with the State Railroad Commission to the effect that the railroads, in order to supply the necessary shifts of telegraphers at the large stations, have closed the telegraph offices at the smaller stations. The companies point out that they cannot afford to maintain three shifts at small way stations.

Net Weight Packages for Paints and Colors.

Leading paint, color and white lead manufacturers have changed all packages of their products sold by the pound from gross weight to net weight. This change went into effect January 1. Heretofore it has been the custom of the trade to put up non-liquid goods in gross weight packages, although liquid goods have been sold by all reputable manufacturers for some years full United States standard measure. This is a step in the right direction because it fixes a definite standard regardless of the shape or weight of the package in which the goods are sold, and enables the consumer to know how much material he is buying. A number of paints and colors are already on the market bearing the net weight on

the labels. All reputable lines of this character will be affected as soon as the various makers can make the necessary changes.

Annual Report of New York State Public Service Commission for the First District.

The New York State Public Service Commission, First district, (New York City), has sent its report to the Senate. It recommends the passage of four amendments to the public service law:

1. A constitutional amendment exempting from the 10 per cent. debt limit bonds for the construction of rapid transit lines when, so far, and so long as such rapid transit lines shall be self-supporting.

2. An amendment to the rapid transit laws providing that leases of extensions of rapid transit lines may be made to terminate at the same time as the original lease, this commission having the power, in conjunction with the Board of Estimate and Apportionment, to fix the terms, conditions and compensation and to readjust the same each twenty or twenty-five years thereafter.

3. An amendment to the rapid transit law which shall give the local authorities and this commission the power to allow the construction and operation of rapid transit lines by private companies upon the payment of part of the earnings to the city or other proper terms and with a reservation to the city of the privilege to purchase at any time after a certain period of not more than twenty or twenty-five years and without any payment for the franchise itself; and

4. An amendment to the rapid transit law authorizing contracts for operation for a longer period than twenty years or else to make the lease terminable at any time after a certain period of not more than twenty years, with a provision that the equipment shall be purchased at a fair price by the city on the termination of the lease.

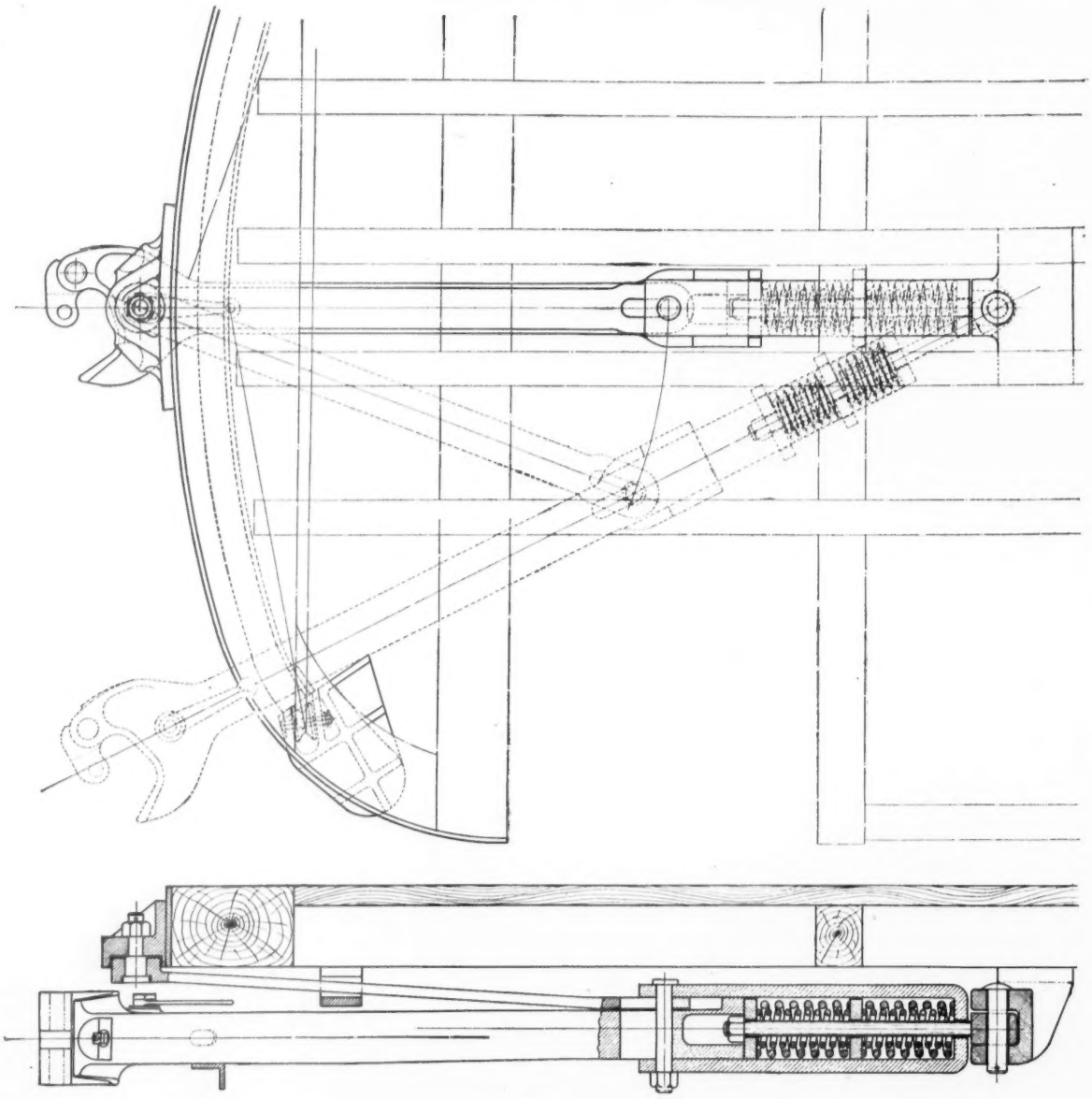
The commissioners have been unable to accomplish anything definite to bring about the removal of surface tracks of the New York Central on Eleventh avenue and West street. For the six months it has been in office the board has held 179 public hearings, and as a result of these hearings the commission has issued 186 orders which have called for increases of from 20 to 25 per cent. in the local railroad services. A conservative estimate of the increases required of all the operating companies indicates that over 15,000,000 additional seats yearly have been added to the service in New York City under orders of the commission. This was accomplished largely through improvements in facilities already at hand. At the same time comprehensive plans for extension of subway construction and important modifications in plans already accepted have been made. Much attention has been given to the extension of subway construction, not only in Manhattan and the Bronx, but in Brooklyn as well. Plans for a Broadway-Lexington avenue subway line, with two branches running into the Bronx, will be submitted to the Board of Estimate this month.

Commenting on the number of accidents in the six months the commission describes the total as "appalling." In the six months ended December 31 last there were 24,209 accidents, the number of deaths being 288. A committee has been directed to make a thorough investigation to ascertain whether it will be possible to adopt any method that will result in fewer persons being killed.

The commissioners report that they have not been able to enforce the 80-cent gas order because of the injunctions which have been obtained by the companies, but it is promised that an appeal will be taken to the United States Supreme Court.

Janney Radial Coupler for Electric Cars.

The accompanying drawing shows a plan and longitudinal section of the Janney coupler with radial movement, designed especially for electric and interurban service, like those shown on model cars at the street railway convention at Atlantic City last fall. It is an adaptation of the Janney M. C. B. type passenger coupler, but has a wide range of lateral movement to accommodate itself to sharp curves. The auxiliary bar, connected at its front end to the platform and at its rear end to the coupler yoke and to the stem of the coupler, prevents lateral buckling of the stem under the impact shock of coupling. The draft spring, acting through this bar, returns the coupler to the approximate center line of the car when the side strains are removed. It has been found desirable to have, on the heavier types of electric and interurban cars, a stronger type of coupler than that previously in service on the lighter cars on city streets; it is also desirable that these cars be equipped to couple with cars of steam roads, which are sometimes hauled over interurban lines or interchanged with them. This coupler fulfills these requirements. It is made by the McConway & Torley Co., Pittsburgh, Pa.



Janney Radial Coupler.

Andrew Carnegie Research Scholarship.

Andrew Carnegie has given the Iron and Steel Institute $89,000 in 5 per cent. debenture bonds. The council of the institute is to use this fund to endow one or more research scholarships annually. Candidates, men or women of any nationality, but under 35 years of age, must apply on a special form before the end of February to the secretary of the institute, 28 Victoria street, London, Eng.

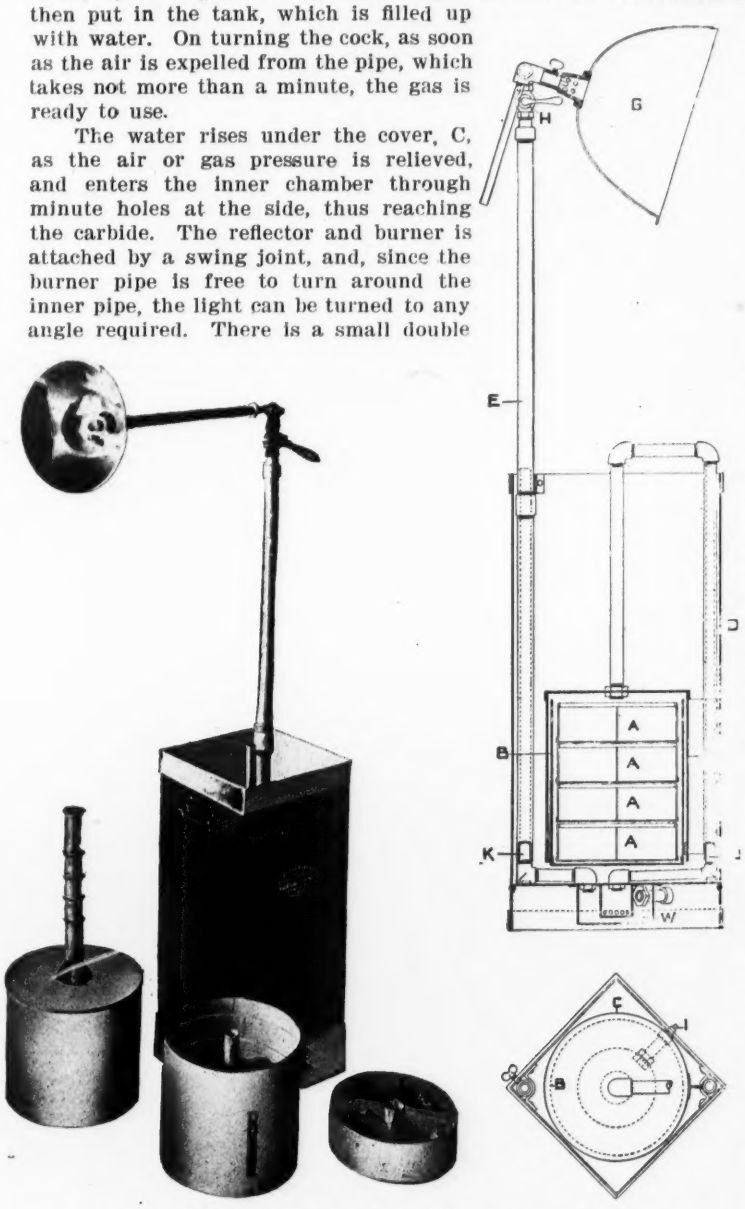
The object of the scholarship is not to facilitate ordinary col-

legiate studies, but to enable students who have passed through a college curriculum or have been trained in industrial establishments to conduct researches in the metallurgy of iron and steel and allied subjects, with the view to aiding its advance or its application to industry. There is no restriction as to the place of research, provided it be properly equipped for such work. The appointment to a scholarship shall be for one year, but the Council may renew it for a further period instead of appointing a successor. The results of the research shall be reported to the institute in the form of a paper at the annual meeting, and, if of sufficient merit, the Andrew Carnegie gold medal shall be awarded to its author.

The Milburn Acetylene Light.

The Milburn acetylene light for construction and maintenance of way work is shown in the accompanying illustrations. The apparatus consists of an outer tank, generally square, a vertical burner standard, and an interior cylinder. The carbide trays, A, are half filled with carbide and nested in the cylinder, B; the cover, C, telescopes over cylinder B and locks itself. The whole is then put in the tank, which is filled up with water. On turning the cock, as soon as the air is expelled from the pipe, which takes not more than a minute, the gas is ready to use.

The water rises under the cover, C, as the air or gas pressure is relieved, and enters the inner chamber through minute holes at the side, thus reaching the carbide. The reflector and burner is attached by a swing joint, and, since the burner pipe is free to turn around the inner pipe, the light can be turned to any angle required. There is a small double



Parts and Sectional Views of the Milburn Light.

chamber at the base of the tank through which the gas passes before going into the burner standard, so that back firing cannot take place; any condensation is drained into the chamber to prevent the pipes becoming stopped up.

Carbide of calcium generally costs from 3½ cents a pound, by the ton, and 3¾ cents a pound, in 100-lb. lots, upwards. Each pound of carbide gives 5 cu. ft. of gas. In the Milburn light burner it is mixed with an unusually large percentage of air, so that the light is inexpensive. The United States Life Saving Service, after tests, reported that with the No. 2 Milburn light fine printed matter could be read at a distance of 360 ft. and objects 600 ft. away were plainly visible.

It can be piped by flexible or permanent tubing to any part of a wrecking car and either a reflector or large open burners can be used. It has been successfully adapted to dredges, cranes and steam shovels. A unique use of the light is for tunnel and sewer work. In one case two lights have been coupled together and a pipe run from these down a 60-ft. shaft and along about 250 ft. of tunneling each way, where a series of burners are used at intervals of about 50 ft. At the ends where the work of excavating is carried on, flexible tubing is used and connected with a tripod bearing several burners; these brightly illuminate the work and can be quickly removed when blasting is necessary.

The No. 3-Z size, giving 5,000 candle power for 16 or 17 hours with an extra cylinder, measures 12 in. square x 36 in. high and weighs only 80 lbs., as outside of the charge of from 12 to 18 lbs. of carbide only water is used; the handling of the light is an easy matter. The Milburn hand lights cost in use less than a cent an hour.

The light is made by the Alexander Milburn Co., 507 W. Lombard street, Baltimore, Md., and among the company's agents are: Manning, Maxwell & Moore, New York, and the Handlan-Buck Manufacturing Co., St. Louis, Mo.

Performance of Large Gas Engines and Electric Generators Under Adverse Conditions.

The Allis-Chalmers Co., Milwaukee, Wis., sends the following: The reliability of large gas engine-driven electrical units under unusual and severe conditions of service was shown during the recent heavy snow and wind storm in the Northwest. Interurban lines centering at Milwaukee, as well as a large part of the street railway system of that city, were completely at a standstill for 24 to 36 hours, with the exception of the Milwaukee-Northern Railway. This line, with power house at Port Washington, on Lake Michigan, 20 miles north of Milwaukee, is supplied with current from one of two Allis-Chalmers alternating current generators direct coupled to four-cycle, double-acting, twin-tandem gas engines made by the same company, each unit being rated at 1,000 k.w. Most of the right-of-way is through a flat, open country, where there was full exposure to the storm. Accordingly precautions had been taken against snow interfering with traffic by putting up snow fences along the worst places, but the storm, very early in the day, destroyed these fences and the tracks were soon covered with snow to the depth of several feet in places.

At this time three large interurban cars, a large snow plow, a large sweeper and four city cars were running. The interurban cars, when going through heavy snow, would take as much as 550 h.p., and the snow plows considerably more. This, together with the city cars, gave the gas engine at Port Washington a swinging load of from 280 to 2,400 h.p. The engine acted extremely well under these trying conditions, picking up the heavy load with apparent ease, and running so quietly that if it had not been for the wattmeter it would have been hard to detect an overload by the action of the engine. Although the cars did not run on schedule time during the day, they were kept going and by nightfall were back to the regular schedule.

Tie and Post Contract.

Joseph Meloney, of Bloomer, Wis., and J. H. Meloney, of Williams, Minn., report that they have entered into a contract with the Grand Trunk Pacific for 125,000 ties and 150,000 posts. This material is to be used for the construction work in Canada. The ties and posts are being cut in the state of Wisconsin, north of Chippewa Falls.

Date Growing in California.

Investigations by the Southern Pacific company have gone far enough to show that the date palm can be grown successfully in California soil. At the Government's experimental farm near Mecca, in the California Desert, several acres have been set out and the trees are thriving. They have not reached the full bearing stage, but several branches have produced as high as 20 lbs. each already. Mr. Fee, Passenger Traffic Manager of the Southern Pacific, has received samples of both the soft and dried dates produced at these farms, and pronounces them of excellent quality.

Kansas, Mississippi, New York and Texas.

The legislature of Kansas is now in session. The Governor in his message told the members that they would be expected to pass a two-cent fare law. In the Mississippi legislature, which is now in session, a bill has been introduced making 2½ cents a mile the maximum fare on the railroads of the state and requiring the railroads to sell 1,000-mile tickets at two cents a mile. A press despatch from Austin says that the railroad commission of Texas has abandoned its proposed reduction of passenger fares in that state, this action being taken, it is said, after the receipt from 16 railroads of

notices that they would abandon their attempt to secure an injunction against freight rate reductions ordered by the commission. The New York State Public Service Commission, Second District, has issued a decision prepared by Commissioner Decker holding that low rates for the use of children attending school, a long existing custom, is desirable, proper and legal. The practice, confined within reasonable limits, is not discriminatory. The two-cent fare law of Pennsylvania has been declared unconstitutional by the Supreme Court of that state.

Steel Ties.

It was mentioned in these columns, December 27, that L. P. Friestedt, of Chicago, had bought the United States patents for the York cross-rolling process. We are now told: "The negotiations which were supposed to have been closed between Mr. York and Mr. Friestedt have been terminated, owing to present unsettled financial conditions; and, as soon as things appear again to be all right, the original intention may be carried out."

INTERSTATE COMMERCE COMMISSION RULINGS.

Export Rate on Walnut Lumber Reduced.

In the case of the Miller Walnut Co. v. Atchison, Topeka & Santa Fe and Gulf, Colorado & Santa Fe, the Commission (opinion by Commissioner Prouty) has decided that the rate of 26¼ cents per 100 lbs. for transportation of walnut lumber from Oklahoma City, Okla., to Galveston, Tex., for export, is unjust and unreasonable, and should not for the future exceed 21¾ cents per 100 lbs.

Reparation on Two Cars of Snapped Corn.

In the case of the Ocheltree Grain Co. v. St. Louis & San Francisco (opinion by Commissioner Prouty) it appeared that previous to December 12, 1906, the rate on snapped corn from Laverty, Okla., to Millican, Tex., and from Laverty, Okla., to Navasota, Tex., had been for a long time 29 cents per 100 lbs., but by tariff effective on that date the rate was advanced to 36¼ cents per 100 lbs. This advanced rate was continued in effect until February 17, 1907, when it was reduced to the former rate, where it stands to-day. On that statement, the Commission declared that it must hold that the rate charged complainant was excessive. The fact that the defendant had for some time maintained a rate of 29 cents and has since reduced its rate to the same figure is in the nature of an admission on its part that this rate is a fair one. Reparation of $58 was awarded complainant for unreasonable charge for the transportation of two carloads of snapped corn at an excess charge of 7¼ cents per 100 lbs.

Rate Fabric Upheld; Indirect Supervision Over Interstate Rates.

The Commission, in an opinion rendered by Commissioner Prouty, has announced decision in the case of Reliance Textile & Dye Works v. Southern Railway et al. The complainant alleged that rates on cotton piece goods from Cincinnati, Ohio, to Chicago, Ill., are so adjusted as to discriminate against Cincinnati in comparison with certain similar establishments at Clearwater, S. C., and Lanette, Ala. The rate on cotton piece goods from Clearwater and Lanette to nearby dye works and from the dye works to Chicago is less than the combination from the mill to the dye works of the complainant at Cincinnati and thence to Chicago. This is because the rates from Clearwater and from Lanette is competitive with rates from New England. The Commission decided that while the lower combination of rates in favor of the southern dye works may be a discrimination against the works of the complainant, it is not, under all the circumstances, undue and therefore unlawful. The complaint was therefore dismissed.

In connection with this decision, the Commission declared that where a discrimination results from the combination of a state and an interstate rate, both established by the same carrier, the matter is not withdrawn from its jurisdiction by the fact that the discrimination is produced by an improper state rate—certainly not when the state rate is voluntarily made by the carrier.

Grain Rates from Buffalo to New York and to New England Reduced.

The Commission, through Commissioner Prouty, has decided several cases covering grain rates from Buffalo to New York City and to New England points. In the case of the Banner Milling Company v. New York Central & Hudson River it appeared that the complainant is engaged in grinding spring wheat flour at Buffalo in competition with mills at Minneapolis, had its rate on flour from Buffalo to New York advanced on May 1, 1907, from 10 cents to 11 cents per 100 lbs., while no similar advance was made from Minneapolis. The Commission held that the 11-cent rate and the rate of 13 cents to New England points were unjust, and should not exceed 10 cents to New York and 12 cents to New England points. The Commmission decided, however, to make no order in the case, pending leave granted to the defendant to establish a proportionate rate on ex-lake grain, which would correct the discrimination.

In the case of the Thornton & Chester Milling Co. v. Delaware, Lackawanna & Western et al., the rate of 13 cents per 100 lbs. from Buffalo to Providence was condemned, but no order was made, the action being similar to that in the Banner Milling Company case.

Similar action was taken by the Commission in the case of the Washburn-Crosby Co., of Buffalo, v. the Erie et al., and in the case of the Washburn-Crosby Co. v. the Lehigh Valley, on complaints of excessive and discriminatory charges on wheat products from Buffalo to New England points.

The case of the Washburn-Crosby Co. v. the Pennsylvania Railroad, attacking the rates on grain and grain products from Buffalo to Philadelphia and Baltimore, was dismissed. It was shown that the failure of Buffalo to obtain differentials given to Philadelphia and Baltimore was due to its location, a disadvantage which the railroad never has attempted to equalize and which the Commission does not believe it ought to be required to equalize.

Philosophy of the Long and Short Haul Law.

The Commission, in an opinion by Commissioner Clark, has announced its decision in the case of the Bovaird Supply Company v. Atchison, Topeka & Santa Fe et al. On rope cables from San Francisco to Independence, Kan., complainant is charged 75 cents per 100 lbs., whereas the rate on such rope from San Francisco to Missouri river points, Chicago, etc., is 60 cents; but the Commission decided that the rate is not shown to be unreasonable.

The Commission views with disfavor the maintenance of a lower rate for a longer haul than for a shorter one included within the longer, and the circumstances and conditions obtaining at the more distant point which are relied upon to justify it must not only be clearly shown to be substantially dissimilar from those prevailing at the nearer point, but also to clearly exercise a potent or controlling influence in making the lower rate.

If the influence of competition, between points of production, in commodities, between carriers, and in rates prevailing at the farther distant point but not at the nearer one controls the establishment of a lower rate to the former, it will constitute such dissimilarity of circumstances as will justify the lower rate for the longer haul.

Competition in commodities alone, at the nearer point, will not make the circumstances there substantially similar to those at the farther point where the other competitive influences and conditions also prevail.

Dissimilar circumstances which justify under Section 4 a greater charge for a shorter haul than for a longer haul will also prevent such rate from constituting an illegal preference or advantage under Section 3.

Upon discovery that shipments have through mistake been moved at an unlawful rate the carrier should forthwith demand and the shipper forthwith pay the difference between such unlawful rate and the legal rate applicable thereto.

TRADE CATALOGUES.

Pipe Coverings.—The revised catalogue of the Philip-Carey Company, Cincinnati, Ohio, is devoted to the many types of Carey coverings, including 85 per cent., 50 per cent. and 35 per cent. magnesia pipe coverings; asbestos and air cell pipe coverings; Argentum air chamber and cork pipe coverings. Other products include: 85 per cent. magnesia sectional blocks and locomotive lagging; asbestos block covering; air cell fire board; magnesia and asbestos cement; Carey cold water paints, and other magnesia and asbestos specialties. Prices are given.

Machine Tools.—Catalogue No. 45 issued by the Newton Machine Tool Works, Philadelphia, Pa., is a new general catalogue. It is 6½ in. x 9¼ in., has 303 pages and is bound in cloth. The press work throughout is excellent. The tools illustrated and described include boring machines, cold saw cutting-off machines, drilling and milling machines, crank and rotary planers, shapers, etc.

Compressed Air.—The December issue of *Compressed Air* includes "The Caisson Work for the Paris Subway"; "Life and Work of the Sand-hog"; "Compressed Air on the Belmont Tunnel Work"; "Steam Consumption in Air Compressors," and the usual departments.

Traction Draft Rigging.—The Edwin C. Washburn traction couplers and draft rigging are fully illustrated in a pamphlet re-

cently published by the Washburn Steel Castings & Coupler Co., Minneapolis, Minn. These devices are particularly adapted for use on curves as sharp as 45 ft. radius. The illustrations consist of photographs and working drawings. The pamphlet also describes steam freight and passenger couplers, engine couplers and spring buffers and cast-steel bolsters for electric cars.

Roller Bearings.—Bulletin No. 103 of the Hyatt Roller Bearing Co., Newark, N. J., is a circular giving some data showing the friction load of shafting in an electrically-driven machine shop when equipped with roller bearings made by this company. The data is the result of tests made at the Dubois, Pa., shops of the Buffalo, Rochester & Pittsburgh.

MANUFACTURING AND BUSINESS.

J. B. Cox, formerly Chief Engineer of the Chicago Junction Ry., has opened an office as Consulting Engineer at 1741 Railway Exchange building, Chicago.

The Hayes Track Appliance Co., Geneva, N. Y., has made the Railway Specialty & Supply Co., Great Northern building, Chicago, agent for the Hayes derail in the Chicago district.

At the recent annual meeting of the American Civic Association at Providence, R. I., Mrs. A. E. McCrea, Landscape Architect of the Chicago, Milwaukee & St. Paul, was re-elected Vice-President and Chairman of the Railroad Department.

The Pittsburgh Lamp, Brass & Glass Co., Pittsburgh, Pa., has made the Railway Specialty & Supply Co., Great Northern building, Chicago, agent in Chicago for the sale of Kopp signal glass. The latter company is prepared to furnish promptly all styles of lenses, roundels and lantern globes.

The Maryland Railway Supply Co. of Baltimore City, 510 Continental building, Baltimore, Md., has been organized to handle steam railroad, electric railway and automobile supplies, working under exclusive territorial contracts in eastern and southern states. Several agencies have already been secured. A general office for New England is to be established at once; traveling salesmen will for the present cover the southern states and other offices will be opened in the north, east and south as soon as the amount of business justifies them. The officers are: President, Nelson E. Perin; Vice-President and General Manager, Charles Elliott; Secretary and Treasurer, Thomas W. Boykin. As Sales Manager of the West Virginia corporation of similar name and as a former railroad officer, Mr. Elliott already has many friends among railroad officers in the South and the personnel of the new company makes its prospects for success of the brightest.

The following reorganization plan for the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa., has been approved by the receivers, the directors and the creditors' committee. Its consummation is subject to subscription by stockholders to $7,000,000 new capital, unless otherwise determined by the committee. The plan provides for $35,000,000 first mortgage and collateral trust 5 per cent. 25-year bonds secured by mortgage on the various plants and by pledge of most of the heretofore unpledged securities of subsidiary and other companies. Part of the bonds are convertible into stock after January 1, 1910. The $18,500,000 convertible sinking fund 5 per cent. bonds and the $1,969,000 5 per cent. debenture certificates outstanding, are to be exchanged, dollar for dollar, for these convertible bonds. The remainder of the first mortgage issue is to take care of the $14,531,000 (about) floating debt. The $6,000,000 three-year 6 per cent. collateral notes maturing August 1, 1910, and the 14,000,000 francs ($2,800,000) ten-year 5 per cent. collateral notes maturing October 1, 1917, are to be exchanged (optional in the case of the ten-year notes) for similar notes with modified collateral and rights to participate in case of deficiency *pro rata* with the new bonds. The personnel of the board of directors is to be approved by the committee. Provision for the election of future boards satisfactory to the committee is to be made by voting trust or otherwise.

Iron and Steel.

The new Grey universal structural steel mill of the Bethlehem Steel Co., South Bethlehem, Pa., is now in operation. The company expects to work up by degrees to the mill's capacity; at present only 12-in. 70-lb. girder beams are being made.

OBITUARY NOTICES.

W. E. Estes, General Freight Agent of the Central of Georgia, died at his home in Savannah last week.

T. L. Courtney, formerly and for many years Superintendent of the Richmond, Fredericksburg & Potomac, died at his home in Richmond, Va., on the ninth of this month at the age of 83.

MEETINGS AND ANNOUNCEMENTS.

(For dates of conventions and regular meetings of railroad conventions and engineering societies, etc., see advertising page 24.)

Franklin Institute.

At the section meeting held January 23 there was an address on Semi-Liquid Steel Ingots by N. Lilienberg.

At the meeting to be held February 28, there will be an address on Electric Power Transmission by Paul A. Spencer.

Western Society of Engineers.

The officers for 1908 are: President, C. F. Loweth (C., M. & St. P. Ry.); First Vice-President, J. W. Alvord (Chicago); Second Vice-President, P. Junkersfeld (Chicago); Third Vice-President, D. W. Mead (Univ. of Wisconsin); Treasurer, A. Reichman (Chicago), re-elected; Trustee for three years, L. E. Ritter (Chicago).

Canadian Society of Civil Engineers.

The twenty-second annual meeting at Montreal will fill three days, Jan. 28, 29 and 30. The first day, Tuesday, will conclude the general business, and there will be an exhibition of lantern views illustrating the Quebec bridge by Henry Holgate. On Wednesday the members will visit the works of the Lakefield Portland Cement Company at Pointe aux Trembles, the new power house of the Montreal Street Railway, and the foundry of Warden King at Maisonneuve, these to be followed by the annual dinner in the Windsor Hotel. The reports will be presented on Thursday.

ELECTIONS AND APPOINTMENTS.

Executive, Financial and Legal Officers.

Acme, Red River & Northern.—T. K. Hawkins has been appointed Secretary, Auditor and Treasurer, with headquarters at Dallas, Texas.

Delaware & Eastern.—Jacob L. Greatsinger has been elected First Vice-President, succeeding E. C. Fairchild.

Maine Central.—Morris McDonald has been elected Vice-President and General Manager in place of George F. Evans, deceased. Mr. McDonald has for 10 years been General Superintendent. George S. Hobbs, Controller, has been elected Second Vice-President.

Susquehanna & New York.—P. M. Newman, hitherto General Manager, has been elected President in place of C. S. Horton, deceased; office at Williamsport, Pa.

Washington County.—Morris McDonald has been elected Vice-President, in place of George F. Evans, deceased.

Operating Officers.

Canadian Northern Ontario.—See Canadian Northern Quebec.

Canadian Northern Quebec.—F. M. Spaidal, hitherto General Superintendent of the Canadian Northern Ontario at Toronto, has been appointed General Superintendent of the C. N. Q., with headquarters at Montreal. A. J. Hill succeeds Mr. Spaidal.

International & Great Northern.—Henry Martin has been appointed Superintendent at Palestine, Texas.

Louisiana Western.—See Southern Pacific.

Missouri, Kansas & Texas of Texas.—W. G. Koch has been appointed Superintendent of the Dallas, the Fort Worth, the Denton and the Henrietta divisions in place of C. H. Scott, resigned.

Morgan's Louisiana & Texas.—See Southern Pacific.

Northern Pacific.—Newman Kline, Assistant General Superintendent, has been transferred to the office of Superintendent at Minneapolis, Minn., in place of M. M. Fowler, who is now Trainmaster.

San Antonio & Aransas Pass.—See Southern Pacific.

Southern.—On account of the resignation of M. M. Richey, E. H. Coapman, Manager, now has authority over the Middle and Western districts, with office at Washington, D. C.

T. C. Laughlin has been appointed Trainmaster at Princeton, Ind., in place of Niles Shaw, who has been appointed Chief Train Despatcher.

Southern Pacific.—William M. Hobbs, hitherto Vice-President and General Manager of the San Antonio & Aransas Pass, has been appointed Manager of the Louisiana Lines of the Southern Pacific, succeeding to the duties of E. B. Cushing, General Superintendent.

H. W. Sheridan, heretofore Trainmaster on the Union Pacific at Green River, has been appointed Assistant Superintendent of the Sacramento division of the S. P.

Traffic Officers.

Chicago, Burlington & Quincy.—H. H. Holcomb has been appointed Assistant General Freight Agent, with office at Chicago.

Engineering and Rolling Stock Officers.

Central Vermont.—W. Kennedy has been appointed Superintendent of Motive Power and Cars, with office at St. Albans, Vt., in place of James Coleman, resigned.

Chicago, Burlington & Quincy.—J. G. Crawford has been appointed Fuel Engineer, with headquarters at Chicago. He will have charge of the inspection of coal.

Great Northern.—M. Flannagan has been appointed Master Mechanic of the Montana division in place of K. M. Froburg.

Kansas City Belt.—W. E. New, heretofore foreman of shops on the A., T. & S. F. at Newton, Kan., has been appointed Superintendent of Motive Power of the K. C. B.; office at Kansas City, Mo.

LOCOMOTIVE BUILDING.

The Orleans Railroad, 8 Rue de Londres, Paris, France, is asking American builders for bids on 10 passenger locomotives.

The New York, Chicago & St. Louis, which was reported as being in the market in the *Railroad Gazette* of December 27, has ordered 10 simple ten-wheel (4-6-0) locomotives, five simple consolidation (2-8-0) locomotives, and five simple six-wheel switching (0-6-0) locomotives from the American Locomotive Co., for February delivery. The specifications are as follows:

General Dimensions.

	10-wheel.	Consolidation.	Switching.
Types of locomotives	10-wheel.	Consolidation.	Switching.
Weight, total	136,500 lbs.	160,000 lbs.	103,450 lbs.
Weight on drivers	105,600 lbs.	142,000 lbs.	103,450 lbs.
Diameter of drivers	62 in.	62 in.	50 in.
Cylinders	19 in. x 24 in.	19 in. x 28 in.	18 in. x 24 in.
Boiler type	Radial stay; ext. w. top.	Radial stay; wagon top.	Radial stay; straight top
" wrkg. steam pressure	180 lbs.	200 lbs.	170 lbs.
" number of tubes	244	306	172
" material of tubes	Iron.	Iron.	Iron.
" length of tubes	13 ft. ⅜ in.	14 ft. 10⅛ in.	11 ft. 1 1/16 in.
Firebox, length	102⅛ in.	96 in.	96 in.
" width	40¼ in.	63 in.	33 in.
" material	.....	Otis steel.	Otis steel.
" grate area	28.54 sq.ft.	40.9 sq.ft.	21.34 sq. ft.
Heating surface, total	1,783.0 "	2,532.0 "	1,121.0 "
Tank capacity	5,500 gals.	5,500 gals.	3,000 gals.
Coal capacity	14 tons.	14 tons.	4.4 tons.

Special Equipment.

Air-brakes	Westinghouse
Bell ringer	Gollmar
Boiler lagging	Keasbey & Mattison
Brake-beams	Waycott
Brake-shoes	American Brake-Shoe & Foundry Co.
Couplers	Climax
Headlights	United States
Injector	Monitor
Journal bearings	Magnus
Piston rod packings	United States
Valve rod packings	United States
Safety valve	Coale
Sanding devices	Leach
Sight-feed lubricators	Nathan bull's-eye
Springs	Railway Steel-Spring Co.
Steam gages	Crosby
Tires, driving wheel	Latrobe

RAILROAD STRUCTURES.

Allentown, Pa.—It is said that the Philadelphia & Reading and the Central of New Jersey are planning a more convenient interchange of traffic from the North Penn division. Plans are under way for putting up a three-track bridge over the Lehigh river at South Bethlehem, and building additional yards and probably new passenger and freight stations in Allentown. The improvements are to cost about $1,000,000. When completed, trains of the North Penn can run through to and from Allentown by using the Central tracks west of Bethlehem.

Beaver, Pa.—Bids, it is said, will soon be asked for by the Pittsburgh & Lake Erie for putting up the proposed steel bridge over the Ohio river, which is to have a total length of 1,787 ft. The cost of the improvement with the necessary changes in tracks and approaches will be about $2,000,000.

Bethlehem, Pa.—Bids are wanted January 25, by Engineer R. E. Neumeyer, for putting up three truss spans and one girder span steel bridge over the Philadelphia & Reading and the Bethlehem Steel Works tracks between William and Anthracite streets, Northampton Heights. The proposed bridge is to be 385 ft. long, and the cost is to be shared by the Philadelphia & Reading, the Bethlehem Steel Company, the Eastern & Pittsburgh Transit Company and the Borough of Northampton Heights.

Brooklyn, N. Y.—The Coney Island & Brooklyn is planning to build six sub-stations this year at a total cost of $250,000.

Fort William, Ont.—This town will raise $50,000 towards building a municipal railway system. Bridges are also to be built over the McKellar, Mission and Kaministiquia rivers.

Fort Worth, Tex.—The Texas & Pacific freight house here, which cost $150,000, was recently destroyed by fire. About $100,000 worth of freight was in the station at the time of the fire and it was entirely destroyed.

Hornell, N. Y.—Announcement is made that the Erie is planning to make improvements to its shops here.

New Castle, Pa.—All objections to the Pittsburgh street bridge having been withdrawn, plans will be made at once to carry out the work. The bridge is to be used by the Mahoning & Shenango Valley Railway & Light Company.

Somerset, Ky.—Plans, it is said, are being made to rebuild the high bridge over the Kentucky river.

Superior, Wis.—Plans have been made by the Great Northern to put up a steel elevator to replace the one destroyed by fire. Schmidt Bros. & Hill, Superior, Wis., and the Minneapolis Steel Company, of Minneapolis, Minn., will have charge of the work. The cost of the improvement will be about $1,000,000.

Wilkesbarre, Pa.—The railroads entering this place are planning to abolish a number of grade crossings within the city limits, and to put up a union passenger station near Market and Northampton streets.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

Buffalo, Rochester & Pittsburgh.—An officer writes in regard to the reported improvements to be made on this road that the only large improvement under way or contemplated at the present time is on a ten-mile section from Carman, Pa., south to Brockwayville, where the line is to be revised and a double-track tunnel pierced, about 1,000 ft. long. Contracts for grading let to Eyre-Shoemaker & Co., of Philadelphia.

Canadian Northern.—Surveys are reported being made for an extension from Regina, Sask., west toward Lethbridge, Alberta, on about 200 miles. (Dec. 6, p. 701.)

Cincinnati, Bluffton & Chicago.—This company now operates 52 miles of main line, having finished last year the extension from Bluffton, Ind., to Huntington, 15 miles, where the company has shops, roundhouses and terminals. It is expected that contracts for work on the southern extension from Portland south to Versailles, Ohio, 35 miles, will be let shortly.

Danville & Bloomsburg Street Railway.—This company, it is said, is planning to build an extension from Danville, Pa., west to Milton, 16 miles.

Dayton, Lebanon & Cincinnati Railroad & Terminal Co.—This company will begin work early this year on an extension of its Dayton branch from Lambeth, Ohio, west to Union Station in Dayton, 1.9 miles.

Hudson & Manhattan Railroad.—The "uptown" tunnels extending from Hoboken to Sixth avenue, New York, have been finished. Experimental trains are now in operation. Forty all-steel cars have been delivered and equipped and are now in the tunnels for preliminary operation. They will shortly be opened to the public for traffic between the station in Hoboken at the Lackawanna Terminal and the station at Fourteenth street and Sixth avenue, New York. A few weeks later the runs of the trains will be extended to Nineteenth street and shortly after to Twenty-third street and Sixth avenue, New York.

Work on the "downtown" tunnels, terminating between Cortlandt and Fulton streets in Manhattan, has actively progressed, the work being pushed by driving shields both from the New Jersey side and from the New York side.

The terminal station building at Cortlandt, Fulton and Church streets, in which is the loop terminal of the downtown tunnels, is nearing completion. The building is to be ready for tenants by April 15 of this year, and the station will be finished by the time the railroad is ready for operation.

The station at the present western terminus of this tunnel, at the Pennsylvania terminal in Jersey City, is about finished and work is progressing on the approach to the river tunnels on Railroad avenue and on the north and south tunnels along the line of Washington street in Jersey City.

The electrical power house at Washington street, Jersey City, is finished and boilers and machinery are being put in. All work is being done for the Hudson & Manhattan Railroad Company by the Hudson Companies—Charles M. Jacobs, Chief Engineer, and J. Vipond Davies, Deputy Chief Engineer. The electrical installation, power and rolling stock equipment are under the charge of L. B. Stillwell, Consulting Electrical Engineer, and Hugh Hazelton, Electrical Engineer.

Hudson Companies.—See Hudson & Manhattan Railroad.

Kansas City, Mexico & Orient.—On the Kansas-Oklahoma division of this road all the track has been laid and train service is

now in operation from Wichita, Kan., south to the Red river, 272 miles. The next section to be finished is from Sweetwater, Tex., north on which track is now laid to a point two miles north of Benjamin, 90 miles, leaving about 69 miles to finish the line to the Oklahoma line at the Red river, where a 3,000-ft. bridge is to be built. On the completion of this work the company will have 431 miles of continuous track laid south of Wichita. Plans are also made to build south from Sweetwater to finish the line to San Angelo, 77 miles. On this section track has been laid for 11 miles from San Angelo north. All the roadbed is graded and all ties and bridge material are on the ground, but the rails are coming slowly.

MASSILLON, WOOSTER & MANSFIELD TRACTION.—An officer writes that this company has given contracts to the Northern Engineering & Construction Company, of Cleveland, Ohio, to build an electric line from Massillon, Ohio, west via Dalton, Orrville, Smithville, Madisonburg, Wooster, Reedsburg, Jeromeville and Hayesville to Mansfield, 50 miles. Grading finished for about four miles between Smithville and Madisonburg. G. A. Bartholomew, Chief Engineer, 1423 Williamson building, Cleveland, Ohio.

MINNEAPOLIS, ST. PAUL & SAULT STE. MARIE.—This company, it is said, has plans under consideration for building an extension from Thief River Falls, Minn., northeast to Roosevelt, on the Canadian border, about 82 miles.

NEVADA NORTHERN.—It is reported that this company is planning to build an extension from its southern terminus at Ely, Nev., southwest to Goldfield, about 170 miles.

NEW YORK & NORTH SHORE TRACTION.—A franchise has been granted this company to extend its line from Foleys Corners, Roslyn, Long Island, east via Manhasset, Great Neck and Thomaston, to Little Neck, about five miles.

NEW YORK SUBWAYS.—The New York Public Service Commission, First district, expects to ask for bids early in February to build six sections of the projected subway from the Manhattan bridge, in the Borough of Brooklyn, toward Coney Island as follows:

From the Manhattan bridge to Willoughby street under Flatbush avenue extension.

Willoughby street to the beginning of Ashland place.

Ashland place to Sackett street.

Sackett street to Ninth street.

Ninth street to a point between 26th and 27th streets.

From the point between 26th and 27th streets to 41st street.

When these contracts are let the Commission will immediately take up the other divisions continuing the line to Fort Hamilton and the spur to Coney Island under New Utrecht avenue, 86th street and Stillwell avenue. (Oct. 18, p. 473.)

PAN-AMERICAN.—This company, which is building a line from the National Tehuantepec Railroad at San Geronimo southeast to the Guatemalan border, 250 miles, expects to have the line finished to Tapachula, 10 miles from the Guatemalan border, next month. The company has money on hand to finish the line, which is already in operation for about 200 miles.

PENNSYLVANIA.—Work on the tunnels under way for the past three years, under 32d-and 33d streets, New York, from the terminal station at Seventh avenue to the East river, are about finished. The final blast was fired recently 60 ft. under Sixth avenue and 32d street. It cleaned the last obstacle in the 32d street tube. The 33d street tube was entirely blasted through some weeks ago. Much work yet remains to be done in the tunnels under the East river, in the Long Island City yards and approaches, and on the Jersey approaches to the Hudson tubes.

WILMINGTON & WESTCHESTER (ELECTRIC).—T. E. O'Connell, Wilmington, the principal promoter of this company, is quoted as saying that work will soon be begun on an electric line from Wilmington, Del., north to West Chester, Pa., 17 miles. A power-house is to be put up at Brandywine Summit.

RAILROAD CORPORATION NEWS.

BALTIMORE & OHIO.—Gross earnings of this system for December decreased over $1,000,000, or 16 per cent.; operating expenses increased $165,000, leaving a decrease of $1,200,000, or 53 per cent., in net earnings. President Murray is quoted as saying that the increase in expenses was more than accounted for by higher rates of pay and the larger charges for depreciation. Over 85 per cent. of the decrease in gross earnings was in connection with the steel industry, particularly in coke, ore and pig iron traffic. In the McConnellsville region alone all lines together in December moved only 23,000 loads of coke as compared with 61,000 in December, 1906. The movement of bituminous coal, which comprises about 50 per cent. of the company's tonnage, showed an increase of over 100,000 tons. This movement was, however, eastbound and therefore less profitable than the usual ordinary westbound tonnage. For the six months ended December 31, 1907, gross earnings were $42,900,000, an increase of $1,100,000, and net earnings $13,000,000, a decrease of $2,000,000.

BOSTON & MAINE.—President Tuttle has filed a petition and bill with the Massachusetts House of Representatives, claiming that the law covering the issue of new railroad stocks and bonds should be changed so that securities may be issued "on such terms and such price as would warrant stockholders in subscribing" for them. The bill submitted with the petition provides that railroad corporations be authorized to issue preferred stock on such terms of preference as the railroad commissioners may approve, and also to issue convertible bonds subject to the same approval.

See New York, New Haven & Hartford.

BUFFALO, ROCHESTER & PITTSBURGH.—Gross earnings for the first two weeks of January, 1908, were 21 per cent. less than for the corresponding period in 1907. In the second week the decrease was 14 per cent.

CHICAGO & ALTON.—A stockholder owning 500 shares of the common stock of the old Chicago & Alton Railroad, which was consolidated in March, 1906, with the Chicago & Alton Railway into the present Chicago & Alton Railroad, has brought suit in the United States Circuit Court at Chicago asking that separate accounts be kept for the old Railroad company and that an accounting of profits wrongfully diverted from it be ordered. The contention is that the old Railroad company was much more prosperous than the Railway company which was consolidated with it in 1906, and that the outstanding stock of the old Railroad company should receive returns in proportion to the profits which are being earned by its individual properties. If the claims of this stockholder are upheld, the economies which were to have been brought about by the consolidation of the two companies in 1906 will be done away with, for it will be necessary to keep separate accounts for the old Railroad company and for the new Railroad (consolidated) company.

CHICAGO GREAT WESTERN.—Since the appointment of receivers the income results for the month of November have been made public. Gross earnings were $715,000, a decrease of 10 per cent.; and net earnings $110,000, a decrease of 50 per cent. For the five months ended November 30, 1907, net earnings were $74,400, a decrease of $592,000, or 44 per cent. Both the showing for November and for the five months are the most unsatisfactory for years.

CHICAGO, ROCK ISLAND & PACIFIC.—The Peoria & Bureau Valley, which is leased to the Chicago, Rock Island & Pacific Railway, has declared a regular semi-annual dividend of 4 per cent. and an extra dividend of 1 per cent. on its $1,500,000 stock.

Speyer & Company are offering $6,000,000 first and refunding mortgage 4 per cent. bonds of 1934 of the Chicago, Rock Island & Pacific Railway at 85½, a yield of 5 per cent. There were already $66,851,000 of these bonds outstanding. The Railway company, which is controlled by the Rock Island Company through the Chicago, Rock Island & Pacific Railroad, has paid dividends of not less than 5 per cent. each year since 1898. These are the first straight long term railroad bonds offered at public sale for some time.

DENVER, NORTH-WESTERN & PACIFIC.—The Denver Steamboat Construction Company was on January 10 incorporated in Colorado with $1,500,000 capital stock to extend the Denver, North-Western & Pacific from its present terminus at Yarmony, Colo., west through the coal fields of the Oak Hills district of Routt county to Steamboat Springs, 68 miles. Contract for this work has already been given by the railroad to the construction company, whose directors are: Col. D. C. Dodge, Henry M. Porter, Lawrence C. Phipps, Thomas F. Walsh, John F. Campion, Charles Boettcher, Charles J. Hughes, Jr., William Byrd Page and Samuel M. Perry, representing mining, cattle, beet-sugar, coal and other interests at Denver and outside interests. Much of the stock of the construction company had been subscribed for before its incorporation.

ERIE TRACTION.—This company, whose road runs from Erie, Pa., to Cambridge Springs, 27 miles, which is on the Erie, is reported to have been bought by the Wells-Fargo Express Company, presumably to prevent the Adams and American Express companies from shipping over it, thus cutting into Wells-Fargo territory. This attempted action of these two companies follows the success of the Wells-Fargo in getting into Pittsburgh over an electric railroad.

GREEN BAY & WESTERN.—Besides the regular annual dividends of 5 per cent. on the A debentures and 5 per cent. on the stock an initial dividend of one-half of 1 per cent. has been declared on the B debentures. The A debentures are entitled to 2½ per cent. if earned, then the stock to 2½ per cent.; thereafter the two share equally. The B debentures are entitled to all

surplus earnings after 5 per cent. has been paid on the A debentures and on the stock.

International & Great Northern.—Estimated gross earnings for the week ended January 14, 1908, were $135,000, against $182,000 in the corresponding week of 1907, a decrease of $47,000, or 26 per cent. This sharp falling off in net earnings is typical of the experience of most other railroads in the Southwest during the last six weeks.

International Traction.—See Mohawk Valley Company.

Kansas City Southern.—Gross earnings for December decreased $92,000, or 12 per cent.; operating expenses increased $64,000, leaving a decrease of $156,000, or 46 per cent. in net earnings. Net earnings, taxes deducted, were $166,000. After deducting one-twelfth of the other fixed charges for the fiscal year ended June 30, 1907, from this sum, there would be left $67,000 for the preferred stock, which is at the rate of 3.8 per cent. a year. It is, of course, not fair to judge of the year's results by any one month, as the results for the six months ended December 21, 1907, show. In this half year gross earnings were $5,000,000, an increase of $700,000, and net earnings $1,700,000, a small increase. The company intimates, but does not say, that a considerable amount was charged to operating expenses during this period, which ordinarily would be chargeable to betterments.

Louisville & Nashville.—An extra dividend of 1 per cent., in addition to the regular semi-annual cash dividend of 3 per cent. declared December 19, 1907, was declared after the close of business on January 18, 1908. This extra dividend is payable in stock of the Louisville Property Company, fractional parts of shares to be represented by non-interest bearing scrip. The Louisville Property Company is a holding company which owns various lands in Louisville & Nashville territory, including coal lands. Its capital stock on June 30, 1907, was $50,000, but this has since been increased to at least $600,000, which amount exactly covers the recently declared dividend. Milton H. Smith, President of the Louisville & Nashville, is President of the Louisville Property Company. The regular dividend of the Louisville & Nashville was declared on December 19 in the usual way, but no announcement of the extra dividend was made until after the close of business on Saturday, January 18. On January 20 the books closed for payment of the dividends.

Mississippi Valley.—This company has been incorporated in Arkansas with $100,000 stock to lease the Portland & Southeastern, which operates 14 miles of railroad in Ashley and Chicot counties. The incorporators are: J. H. Bird and M. G. Price, of St. Louis; H. L. Pitman, C. C. Curl and C. Sawyer, of Ashley county.

Missouri, Kansas & Texas.—Net earnings for the month of November were $512,000, against $1,007,000 in 1906, a decrease of 52 per cent. Fixed charges were $553,000, leaving a deficit of $41,000 for the month, against a surplus of $666,000 for the month of November, 1906. This decline came after a long period of great prosperity. Gross earnings for the month decreased $449,000, owing to the almost entire lack of cotton shipments, the reduction in traffic in coal and manufactures and legislative rate reductions, while operating expenses increased $139,000, owing to higher cost of materials and labor and legislative restrictions on operations.

Mohawk Valley Company.—It is reported that the International Traction Company, which operates 217 miles of line, including all the street railway mileage of and between Buffalo, Niagara Falls, Lockport, Tonawanda and North Tonawanda, N. Y., is to be acquired by the Mohawk Valley Company. This acquisition would greatly strengthen the Mohawk Valley Company, which already controls the street railway systems of Rochester, Syracuse and Utica and jointly with the Delaware & Hudson, of Schenectady. The D. & H. owns the street railways in Troy and Albany. The Mohawk Valley Company also controls several interurban lines, including a line from Utica to Syracuse. The New York Central owns 60 per cent. of its stock.

Nevada Central.—An interest payment of 2½ per cent. is being made on the $750,000 first mortgage 5 per cent. non-cumulative income bonds. The last previous payment on these bonds was 4 per cent. in July, 1906. The road is narrow gage and runs from Battle Mountain, Nev., to Austin, 93 miles.

New York Central Lines.—Nearly all of the $30,000,000 5 per cent. equipment trust certificates recently offered have already been sold. Of these, $20,389,000 were issued against the following equipment which has been or is about to be delivered to the following companies:

New York Central & Hudson River—165 locomotives, 76 passenger cars, 1,000 gondola cars, 1,000 flat cars and 2,000 box cars.
Lake Shore & Michigan Southern—125 locomotives, 25 passenger cars, 200 ballast cars, 1,000 hopper cars, and 2,000 gondola cars.
Boston & Albany—79 locomotives, 12 passenger cars.
Michigan Central—15 passenger cars, 200 ballast cars, 500 flat cars and 1,000 gondola cars.
Cleveland, Cincinnati, Chicago & St. Louis—107 locomotives, 31 cabooses, 100 ballast cars, 250 flat cars, 250 hopper cars, and 500 gondola cars.
Chicago, Indiana & Southern—8 passenger cars, 150 ballast cars, 300 flat cars, and 100 hopper cars.
Peoria & Eastern—500 gondola cars.

New York Central & Hudson River.—See Mohawk Valley.

New York, New Haven & Hartford.—Butler Ames, Representative in Congress from Lowell, Mass., has issued a statement favoring the consolidation of the Boston & Maine with the New York, New Haven & Hartford in view of the following advantages to be gained: Better freight and passenger rates; transfer accommodations around Boston between the two roads; electrification of suburban lines about Boston; a large saving in equipment and reduction of about half of the cost of management. Mr. Ames says that control of the Boston & Maine was not sought for by the New Haven, but that a block of stock sufficient to give control of the property was seeking a market, offered to the New Haven and the offer accepted. He regrets that this stock was not bought by citizens of Massachusetts, but believes that since it was not, control by the New Haven is preferable to that of any other railroad in the United States or Canada. He also points out that the interests of New England are a unit as against the interests of the territory west of the Hudson river in the matter of rates and traffic. He also calls attention to the fact that less than carload lots shipped from any point on the Boston & Maine to any point on the New Haven and *vice versa* now are transferred from car to car at junction points. He urges that two members of the board of directors of the consolidated system should be named by the Governor of Massachusetts.

Northern Electric.—The Northern Electric Railway, incorporated on September 19, 1907, in California, with $10,000,000 5 per cent. non-cumulative preferred stock, of which $5,000,000 is outstanding, and $15,000,000 authorized common stock, has acquired the properties of the Northern Electric Company, which include a line from Chico, via Oroville, Yuba City and Marysville to Sacramento; also the Shasta Southern (Electric) Railway operating between Chico and Hamilton. The Northern Electric Railway has made a first consolidated mortgage securing $25,000,000 5 per cent., 40-year gold bonds dated December 1, 1907, none of which are as yet outstanding. The company is now operating more than 100 miles of track and plans to build over 300 miles more.

Pennsylvania Lines West.—The Pittsburgh, Cincinnati, Chicago & St. Louis reports for December, 1907, an estimated decrease of $500,000 in gross earnings and a decrease of $200,000 in operating expenses and taxes, leaving an increase of $300,000 in net earnings after taxes. This would seem to show that this company is able to reduce expenses to meet the decreased earnings.

For the year ended December 31, 1907, gross earnings increased $2,700,000 and operating expenses and taxes $2,500,000, leaving an increase in net earnings after taxes of about $200,000.

Peoria & Bureau Valley.—See Chicago, Rock Island & Pacific.

Pittsburgh, Shawmut & Northern.—Part of an issue of $592,000 5 per cent. car trust bonds issued by the receiver of this railroad, and of the Shawmut Mining Company and the Kersey Mining Company, dated November 1, 1907, and maturing from 1908 to 1914, have recently offered for sale at a price yielding 6½ per cent. for the 1908 maturity and 7 per cent. for each of the other maturities. These bonds cover three locomotives and 500 steel underframe coal cars of 100,000 lbs. capacity, 10 per cent. of whose cost has been paid. Owing to the fact that they are issued by the receiver, they have, besides the usual advantages of an equipment trust, a lien prior to existing mortgages on the properties of the three companies.

Portland & Southeastern.—See Mississippi Valley.

Texas & Pacific.—Estimated gross earnings for the two weeks ended January 14, 1908, were 24 per cent. less than for the corresponding period in 1907.

Third Avenue Railroad.—Former District Attorney J. Addison Young, of Westchester county, has been appointed temporary receiver of the Westchester Electric Railway, which operates the electric lines at Mt. Vernon, N. Y., and of the Tarrytown, White Plains & Mamaroneck, which operates electric lines between these three points. Former County Clerk Leslie Sutherland, of Westchester county, has been appointed receiver of the Yonkers Railroad, which operates electric lines in Yonkers and thereabouts. These companies are all controlled by the Union Railway, which stock is owned by the Third Avenue Railroad, which, previous to the recent appointment of a separate receiver for it, was leased to the Metropolitan Street Railway, which was leased to the New York City Railway.